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A STUDY OF FARM EQUIPMENT

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INTRODUCTION

Successful farm management presupposes a proper relation between the various factors of production. The process of adjusting land, labor and capital into harmonious relationship is consciously or unconsciously followed by all farmers. In the course of time the successful farmer reaches the point where productive area, live stock, cropping system, labor, equipment, and working capital are properly balanced and a profitable routine may be followed. Before that point is reached, however, many expensive mistakes are usually made, and perhaps none are more keenly felt than those arising from improper distribution of capital.

The study of farm equipment was undertaken for the purpose of determining from the study of successful farms the proper relationships that should exist between investments in land, improvements, livestock, machinery and tools.

This report presents the results of a study of equipment on a number of farms where conditions were unusually favorable for securing the desired information. The data and observations would undoubtedly have been more complete and satisfactory had a thorough preliminary analysis of the situation been possible in the light of later knowledge. They are presented, however, as secured, in order to illustrate by concrete example numerous problems that arise in this field of investigation. A portion of the data secured in these investigations has already been published*.

*Circular 98, of this Station, regarding "Minor Items of Farm Equipment". This will be sent free on application to the Ohio Experiment Station, Wooster, Ohio.

METHODS OF PROCEDURE

The work was done under the joint auspices of the Office of Farm Management, U. S. Department of Agriculture and the Ohio Experiment Station. During February and March, 1909, in connection with the annual inventories on the farms of about thirty-five statistical cooperators, a detailed study of the equipment was made in so far as it was possible to secure information from the proprietor or manager. Specially prepared forms were used in order to obtain full details. Previous field measurements of the various farms by Mr. H. C. George of the Experiment Station gave accurate data as to the size of each, the areas devoted to different purposes, the length and character of fences and certain other details. Measurements and sketches were made of the buildings, and numerous details as to their character and condition were noted. The extent, character, and cost of water supply and drainage systems were studied.

The usual inventory of livestock, machinery, tools and supplies was made to include many details in addition to mere values. Messrs. Abbot, Bugby, Elser and Lloyd of the staff of the Experiment Station assisted at various times in the field work, and Mr. C. A. Massaro of the Department of Cooperation assisted in the compilation of the data.

In the case of every farm studied, difficulty was encountered in securing all the details desired. Especially was this true in the matter of cost of permanent improvements, the installation of which usually antedated the tenure of the incumbent proprietor. The determination of the present value of real and personal property was also especially difficult, as a uniform basis could not be maintained for the reconciliation of exchange value with the value in use.

Previous to the work just mentioned, about twenty successful Ohio farms were visited by Mr. H. C. Thompson, of the Office of Farm Management, and less complete equipment studies made. Some data from this source are included in this report. A third source of data consists of circular letters dealing with corn and tillage machinery which were sent out in 1908 to a selected list of Ohio farmers. Over 100 carefully prepared reports of this character have been drawn upon for material.

CHARACTER OF FARMS STUDIED

The farms from which data were secured for this report are probably above the average in the character of the proprietors, methods and equipments, yet not necessarily examples of exceptionally successful management. They are well scattered over the

state, as shown in Fig 1. Only those visited in 1909 were analyzed as to the chief enterprises conducted. For convenience, these have been numbered as in the various tables presented later. On 23 of these farms it was found possible to make a complete distribution of investment by enterprises, and it is with these that this report has chiefly to deal. Data from two of these are excluded from the averages given later, one being a small truck farm and the other a general farm on which conditions had operated to reduce the equipment investment to an abnormally low figure. Figures from both are made available for comparison as well as those from a number of farms on which the analysis could not be completed.

Fig. 1. Showing location of farms studied

TABLE I. COMPARISON OF AVERAGE DATA FROM 21 OHIO FARMS WITH STATE AVERAGES FROM THE CENSUS OF 1900.

	State average			Average of 21 farms		
	Per farm	Per acre	Percent	Per farm	Per acre	Percent
Area in acres	88.5	.....	.....	165.88	.....	.....
Total value of land, improvements, livestock and machinery	$4,333.	$48.96	100.00	$14,461.10	$87.17	100.00
Value of land, fences, drainage, water supply, etc	$2,953.	$33.37	68.16	$ 8,748.56	$52.72	60.48
Value of buildings	$ 793.	$ 8.96	18.30	$ 3,049.47	$18.38	21.08
Value of implements and machinery	$ 132.	$ 1.49	3 04	$ 773.92	$ 4.67	5.36
Value of livestock	$ 455.	$ 5.14	10.50	$ 1,889.15	$11.40	13.08
Percentage of improved land in farms*	78.5	.....	.....	80.9	.....	.....

*In the state average this includes all land regularly tilled or mowed, land pastured and cropped in rotation, land lying fallow, land in gardens, orchards, vineyards or nurseries, and land occupied by buildings. No instructions were given to census enumerators as to the disposition of public and private roads, all or part of which may be included in the farm areas covered by deeds.

In the average for the 21 farms, waste lands, roads and barn lots are classed together as non-productive. Pastures, tilled fields and orchards constitute 80.9 percent of the total area. See Table III for details of acreage.

The 21 farms represented in the tables showing average distribution of investment range from about 50 to 400 acres in size, averaging about 166. In this and other particulars they differ materially from the state averages as reported in the Twelfth Census (1900). According to the census report 32.4 percent of the farms of the state were between 50 and 100 acres and 24.3 per cent between 100 and 175 acres in size. Table I presents a comparison of the average of the 21 farms and that of the state as shown by the census. It will be remembered, however, that the census valuations are made on the basis of sale values. In taking the inventories, consideration was given to both this sale value, and the original cost of property less a reasonable depreciation charge based on its condition and length of time already in use in proportion to its expected total life. This will lessen the apparent difference between these farms and the average for the state.

Of the 21 farms six include dairying as the principal enterprise, one is devoted largely to feeding sheep, and two more place greater emphasis on the feeding of cattle than the average farm, but in no instance are the equipment and management those of a highly specialized type of farm. They represent, on the whole, the most common type of farm to be found in the state, with the exceptions previously noted. Concerning the farms visited by Mr. Thompson and those covered by circular letter, it may be said that they represent the general rather than any special type, and are probably better organized, equipped and managed than the average of all farms in the state. It is the equipment of this class rather than that of highly specialized farms or that of groups including both the best and poorest examples of farming that has been studied in the endeavor to establish logical relationships between the land, improvements, stock and machinery required for successful operation. The data hereinafter presented are conclusive only in so far as the farms studied are typical. It is held, however, that similar analyses of a large number of farms in any section would afford reliable averages from which the proper distribution of capital in equipment for a given farm could be predetermined with scientific accuracy.

DISTRIBUTION OF INVESTMENT

There are three distinct objects sought in this study of farm equipment: (1) The amount of equipment necessary and its first cost; (2) The inventory valuation at a given time; and (3) The equipment charge on farm operations, a portion of which is represented in the difference between the first cost and a succeeding

inventory valuation. The second phase will be discussed first, i. e., the present distribution of investment as shown by inventory. Land, Buildings, Fences, Drainage, Water Supply, Livestock, Machinery and Tools, and Produce and Supplies are regarded as the principal divisions of equipment. These classes are also divided among the enterprises. The enterprise, rather than the farm, was regarded as the unit.

LAND

In Table II is shown for 1909, the distribution of acreage by enterprises for the various farms. Under "General farm" is included areas in lots, lanes, waste spots, public roads and all other lands belonging to the farm which cannot properly be charged to one enterprise or a group of enterprises. "Household" includes door-yard and family garden, also the orchard where the latter is not at all a commercial proposition. Tenant yard, garden, etc., are charged to "Labor." "All stock" refers to all lots and fields devoted exclusively to livestock. Where pastured fields contained any considerable growth of trees, the judgment of the surveyor was relied upon for a division of the field into pasture and woodland. Temporary pastures are included under this head, hence the areas devoted to "All stock" and "All crops" would vary from year to year. Under "All crops" are included all tilled and mowed fields. On several farms, certain groves, considered as permanent, were maintained largely for the production of maple sugar or syrup, hence the occurrence of a "Sugar" enterprise. Under "Orchard" are included only fruit orchards largely commercial in nature. "Woodland" comprises not only natural tracts but those planted for the production of wood, posts, etc. The value given for the bare land represents as accurately as possible the value after all improvements are removed.

An examination of Table II shows that the mean acre valuation for 21 farms is $45.96. On farm No. 1 the acre valuation. of bare land is $61.62. On farm No. 2 it is $19.53. These farms are both in the northeastern part of the State and are both dairy farms. No. 1 is a mile and a half from town on a stone pike, while No. 2 is five miles out on a dirt road. Part of the woodland in No. 1, but no distinct area, produces maple syrup in commercial quantities Farm No. 4, with an acre valuation of $31.15, and farms Nos. 8, 9, and 10, with respective acre valuations of $87.74, $65.99, and $71.00, are all level farms. No. 4 needs considerable drainage. Nos. 8, 9, and 10 are well equipped with tile drains. Also Nos. 8 and 10 show

a high percentage of land in crops, i. e., 74 percent and 84.2 percent respectively, as against a mean of 52.8 percent for the whole 21 farms. No. 25, with 91.9 percent of land in tilled crops and situated within a stone's throw from an interurban railway, shows a bare land valuation of $40.10 per acre. This farm, however, lacks tile drainage and is over-equipped with buildings as compared with other farms. (See Table III for data on Building Equipment.) No. 3, with an acre valuation of $41.44, has also a very expensive building equipment, and even when this equipment is placed at a very low figure compared with its cost, it leaves a low figure for bare land. No. 14, although the largest farm of all, with a total of 388.92 acres, has but 50.7 percent of the land in crops, the mean being 52.8 percent. It contains, however, a large acreage of productive bottom land, has a low building investment per acre, and has good roads to a shipping point, which gives the bare land an acre valuation of $60.00, as compared with the mean average of $45.96 for the 21 farms. Farms Nos. 20, 21, 22, and 23, with bare land valuations of $43.97, $22.26, $25.55, and $29.59, respectively, are all located in the hill section (southeastern part) of the state. No 20, with a valuation of $43.97, shows an unusually low area in waste and timber land for a hill farm and is connected with town by 6 miles of pike road. No. 23, with a valuation of $29.59, and with nearly the same size, distribution of acreage, and distance from railway station, is separated by 3 miles of hilly dirt road from the pike leading to town. No. 21, with a valuation of $22.26, has considerable waste and timber land, and No. 22, with a valuation of $25.55, has been wisely kept in pasture for the greater part, though a greater area in crops would have made it more attractive to a buyer. Nos. 12 to 17 inclusive ranging in bare land value from $43.90 on farm No. 15, to $64.89 on farm No. 17, are located in the large farm area of central and southwestern Ohio. Only one of this group falls below the average bare land valuation of $45.96. These farms are well equipped with buildings and are quite easily reached by pike roads from good towns. Most of them show a higher percentage of crop land than the mean of the whole number and are in a high state of productivity. No. 24, with a bare land valuation of $19.61, is located in a rougher section in southern Ohio, is under-equipped in buildings and is conservatively valued rather than otherwise.

From these examples the land values, due to good roads, good drainage, high crop areas, good topography, and adequate improvements can be plainly seen.

TABLE II. ACREAGES ON 23 FARMS DEVOTED TO VARIOUS ENTERPRISES, WITH THE AVERAGE AND PFRCENTAGE OF THE TOTAL ON FARMS NOS. 1 TO 23 INCLUSIVE, AND THE VALUE OF THE LAND MINUS ALL IMPROVEMENTS

Farm No.	General farm	House-hold	Labor	All stock	All crops	Sugar	Orchard	Wood-land	Total	Percent in crops	Value of bare land
1	.93	.88	....	56.43	35.86	.....	.....	22.10	116.20	30.8	$61.62
2	3.86	2.33	....	54.42	68.14	.....	.....	35.36	164.11	41.5	19.53
3	3.68	1.66	....	16.97	53.71	.....	14.43	13.80	104.25	51.5	41.44
4	4.38	1.36	....	25.96	56.22	16.35	4.07	.....	108.34	51 8	31.15
6	4.28	3.57	....	37.50	73.65	23.27	.....	1.05	143.32	51.4	24.18
7	4.07	1.69	....	18.98	20.80	.....	.....	4.07	49.61	42.0	33.00
8	2.94	2.03	....	14.52	58.15	.....	.....	1.00	78.64	74.0	87.74
9	5.41	1.02	.35	31.93	82.96	.....	.....	26.00	147.67	56.1	65.99
10	5.44	1.34	....	5.00	84.19	.....	.....	4.03	100 00	84.2	71.00
12	1.83	2.20	....	28.34	104.60	.....	.....	20.00	156 97	66.7	50.14
13	4.93	3.63	....	33.02	140.76	.....	.....	15.91	198.25	71.0	46.55
14	8.98	3.67	....	122.60	197.00	.....	.....	56.67	388.92	50.7	60.00
15	4.83	3.26	....	67.75	128.85	.....	.....	15.13	219 82	58.6	43.90
16	3.35	1.62	....	11.84	116.42	.....	. ....	39.29	172.52	67.5	45.97
17	10.38	2.65	.49	84.93	124.47	23.05	.....	30.02	275.99	45.1	64.89
18	8.40	1.45	....	26.32	123.20	.....	3.71	44.75	207.83	59.4	56.49
19	3.00	1.65	....	21.81	69.42	.....	.....	7.93	103.81	66.8	40.17
20	7.18	.50	....	84.31	84.56	.....	.99	7.71	185.25	45.7	43.97
21	14.11	1.47	.73	62.44	68.58	.....	4.79	76.50	228.62	30 0	22.26
22	3.33	1.46	....	103.84	31.17	.....	2 44	13.76	156.00	19.9	25.55
23	10.31	3.36	....	67.66	77.30	.....	10.49	8.15	177.27	43.5	29.59
Average of 21 farms	5.51	2.04	.08	46.50	85.71	2.98	1.95	21.11	165.88	(mean) 52.8	(mean) 45.96
Percent of total acreage	3.32	1.23	.05	28.01	51.68	1.80	1.18	12.73	100.00	....	.....
24	3.85	1.56	....	47.00	79.23	.....	. ....	23.04	148.38	48.2	19.61
25	.65	.23	....	.....	9.97	.....	.....	.... .	10.85	91.9	40.10

PERMANENT IMPROVEMENTS

The appraisement of the real value of permanent improvements in this study was extremely difficult and must be accepted with due allowances. Wherever practicable, the basis for fixing values should be that expressed in the following question: "What is the value of this item as a part of the equipment of this farm, remembering that the sum of these values must equal the value set upon the farm as a whole?" Land values have increased in nearly every section, not through improvement of the land by farming, unfortunately, but through an advance in land as a raw material. We have no means of determining the present producing power of a given farm as compared with that at the outset, nor what its rate of appreciation or depreciation has been in this respect. It seems well established that where systematic steps have not been taken to prevent it, or to repair damage, there has been a steady depreciation in the productiveness of any given farm. The buildings and other improvements on such a farm may clearly have undergone a process of deterioration, yet the sale value of the farm may have been enhanced, not only by the rise in land value but by the increase in value of the raw materials from which improvements are constructed. Well planned improvements may add value to the farm above their cost of installation, and others may immediately represent the loss of a large part of their cost if measured by their effect on the farm value. Each farm, therefore, was studied as an individual problem, and is most interesting when considered in that light.

DRAINAGE

Tile drains are so intimately associated with the land that it may be impracticable to consider them separately. With the possible exception of cost of water supply, the outlay in tile drainage is the only one which can be depended upon to add its face value or more to the value of the bare land and continue to do so indefinitely. The drains occasionally become clogged and require cleaning but in this study they have been appraised at the full cost of installation. To attempt to appraise them accurately on the basis of their effect on the farm value would be impossible from the information at hand. No valuation has been placed on natural drainage channels considered aside from the land. The investment in artificial drainage systems has been attributed directly to the portions of the farm drained.

WATER SUPPLY

On many Ohio farms there are natural sources of water supply which, like natural drainage, can scarcely be valued apart from the land. Their value may not equal their cost, as in the case of streams which permanently render a considerable area unavailable

for cropping, or which subject fields and fences to damage from high water. On the other hand, the value of a continuous supply of pure water in a convenient place, without expense or labor, cannot be estimated by comparing it with the cost of installing artificial water systems. The latter may represent several failures before a satisfactory supply is obtained, and will surely represent a continual expense for labor and maintenance. In distributing the investment for the purposes of this study, only the cost of installing the water system has been considered, less a fair amount for depreciation of pumps, tanks, windmills, etc. This total investment in water system has been divided as accurately as possible among the various enterprises on the basis of use. This naturally places the heaviest charges on the household and those classes of livestock which do not have access to natural sources in the fields.

FENCES

Fences well planned and constructed undoubtedly add at first more than their cost to the value of farms, yet if not well located they may prove a handicap to the most profitable cropping systems. They are subject to quite rapid deterioration, involving considerable attention and expense, hence over-equipment in fences may tend to reduce land values.

Certain phases of the fence question were studied in detail and will be discussed later, but in ascertaining the investment in fences the first cost and the condition at the date of inventory were the only points considered. The cost of construction was difficult to obtain, owing to the fact that practically all fences are built by farm labor, and standard costs per rod have not been established as has been done, for instance, for the digging of ditches for tile drains, which is often paid for on a unit basis. The price of posts varies widely in different localities and has generally advanced since the building of the older fences.

The value of fences, therefore, was based largely on the cost of replacing them, less a fair percentage for depreciation. Worm rail fences constitute a large proportion of the total on many Ohio farms. When built, the value of the material was practically disregarded. Labor costs were very low as compared with the present rates. It would be impossible to replace these fences except at a prohibitive cost, yet in real value to the farm they are no higher than modern fences. Many are in an excellent state of preservation, yet occupy enough additional ground to offset any advantages they may have over wire fences. As an expedient they have been valued at a figure approximating the labor cost of building. All fences were charged to "General farm", only the farm's share of division fences being included, of course.

BUILDINGS

Many buildings found on the farms studied are from 40 to 75 years old and of a type of construction not commonly used at present the frame being composed of large, hewn timbers. Much of the other material has been cut and sawed on the farm, the value of the timber at the time being very low as compared with present prices. These buildings, as a rule, are still in such condition as to be capable of long service without excessive repairs. The first cost of material and labor was low, yet on the present basis it would be almost out of the question to duplicate the buildings.

It follows, then, that neither the cost of the buildings nor the cost of replacing these structures can be relied upon absolutely in appraising their value. As previously stated, the cost of the more modern buildings is not a true indication of their value to the farm, yet insurance figures are quite largely based on their condition and the cost of replacing them. A comparison of the sale values of land without buildings and land with buildings, all in the same neighborhood and of equal productiveness, shows that the difference in favor of the latter is almost without exception greatly insufficient to equip the unimproved land without buildings with those structures which are absolutely necessary to the conduct of an independent farming enterprise. The real value of farm buildings as a part of the total investment is, therefore, very difficult to ascertain, and depends largely upon the point of view.

In this study the building values are a compromise between the cost of equipping the farm with similar structures, less a proper amount for depreciation, and the sale value of the buildings as suggested by comparing the values of land with and without buildings. The value shown for the bare land, therefore, is reduced somewhat by this method, possibly to as great an extent as it was elevated by the method of appraising the fence, drainage and water supply systems.

It can safely be said that buildings represent not only the most expensive class of farm equipment, but the least negotiable. Leaving out household buildings, the remainder on the farms studied shows a much greater variation in investment per acre than any other class of equipment and greater variation in percentage of the total investment than land, water supply, livestock or machinery. Fences and artificial drainage and water systems may often be dispensed with wholly or to a great extent, hence are scarcely comparable with land, buildings, livestock and machinery as regards the relative investment.

One of the most important phases of a study of farm equipment is that of determining the relation that should exist between buildings and the farm enterprises, in order to reduce the wide variation

in investment per acre in buildings designed for the same purposes. Prior to a study of the cost and construction of buildings, there should be established standard space units, to be used in determining the actual building requirements of the farm for the storage of products and machinery, the housing of livestock and the transaction of the farm affairs. In this study, buildings were investigated from that standpoint, but insufficient data were secured to allow of generalizations.

For purposes outside of this study it became desirable to make a division of building investment by enterprises. As the floor and cubic space devoted to each enterprise had been calculated for the various buildings; a division on the basis of cubic space was worked out, and is presented later in tables and discussions.

It will be at once apparent that a division of space on the basis of cubic feet devoted to various enterprises in barns, for instance, is open to serious criticism. This subjects such products as hay, straw, etc., stored in mows, to greater building charges than horses and cattle, for which greater expense is incurred in constructing stalls, mangers, floors, etc. In order to correct this error, additional study of the cost of construction of the various portions of the buildings would be necessary, and the need for this did not occur in time to include it in the scope of this study.

Factors for the relative cost of various portions of farm buildings of ordinary construction could no doubt be worked out, by means of which the cubic space devoted to any enterprise could be made the basis for an equitable division of the total value. Some method is desirable, as it is incorrect to charge livestock enterprises with the investment in portions of the buildings devoted to other enterprises. Animals may be fed grain in the barn for a short time each day and pastured outside, while both hay and grain may be stored in the barn continuously for market. A storage charge, in the latter case, should unquestionably be added to the cost of production. It is only logical to base the unit charge on the amount of the commodities stored, taken in connection with the total annual cost of that part of the building designed exclusively for storing products. A unit storage charge based on cubic space would place on the proper classes of livestock the burden of the large amount of storage space required for roughage. A division of the entire building charge on the basis of the number of 1,000 pound-shead of stock sheltered, or on the floor space occupied, might be unjust to the hog enterprise, for which a comparatively small space is required for storage of feed. A tool room, workshop, driveway, or other space may be used for storing tools, wagons and machinery, for storing and

preparing seed, and for other purposes which are obviously not associated with livestock enterprises. Conceding the partial inaccuracy of a division of building values on the basis of cubic space occupied, it is contended that even this method results in a distribution of building charge more nearly correct than one based on the number, size or value of livestock alone. Considering the importance of the building equipment, it is unfortunate that so little investigation has been conducted with a view to discovering the fundamental principles involved in the economical planning of farm buildings.

PERSONAL PROPERTY

All personal property has been valued with due consideration for both exchange value and value in use. Marketable livestock and products were invoiced at the prevailing prices. Work animals and machinery, however, have a value to the farmer not necessarily the same as that which would prevail either in public or private sales. This fact has been taken into consideration, hence the values presented for the work horses, mules and machinery are usually higher than sale values. The sale values could, at best, have been approximated. All products of the farm, all feed, seed, building material, fuel and supplies of any kind held in storage for sale or for the use of the farm (not household) business, were inventoried at actual values so far as they could be determined.

Table III shows the total investment in different classes of equipment for the various farms, distributed as explained in the preceding pages. The area, 342 acres, given for Farm No. 5, was not verified by the surveyor from the Ohio Agricultural Experiment Station. The proprietor of Farm No. 11 could not give the extent nor value of the tile drains; hence this value is included in that of the land. A very slight quantity of tile is included in the land value for farm No. 16. The total investment is shown for the different farms to vary from $35.21 to $166.30 per acre and this is brought out even more clearly by Table IV, which reduces all the investment to the acre basis. The variation in total value of household buildings ($310 to $6,110) is interesting from the fact that the investment in this direction is usually not based on the absolute needs of the farm. The variation in the amount of produce and supplies on hand ($10.10 to $1,942.15) is due partially to the fact that the work of taking the inventories lasted over a period of six weeks, during which time of course, the consumption of feed continued. For comparable data, all inventories, particularly of supplies, should be taken on the same date. In this study, except as affecting the percentages of the total investment shown later, the amount of supplies on hand is unimportant.

TABLE III. TOTAL INVESTMENT IN THE DIFFERENT CLASSES OF FARM EQUIPMENT ON 25 OHIO FARMS

Farm No.	Acres	Land	Farm buildings	Household buildings	Fences	Drainage	Water supply	Livestock	Machinery etc.	Produce, supplies, etc.	Total	Acre investment
1	116.20	$ 7,160	$1,025	$1,500	$ 245	$ 45	$ 50	$1,265.00	$ 667.50	$ 220 85	$12,178.33	104 81
2	164.11	3,205	1,000	800	250	85	60	1,651.20	623.95	520.22	8,195.37	49.94
3	104.25	4,320	2,800	2,500	455	250	100	1,363.75	664.25	671.95	13,124.95	125 90
4	108.34	3,375	1,405	700	320	30	170	1,336.25	682.34	329.02	8,347 61	77.05
5	342.00	9,570	6,250	6,110	1,255	2,795	700	3,549.00	1,065.80	1,942.15	33,236.95	97.18
6	143.32	3,465	900	900	565	.....	170	1,767 68	1,086.68	323.50	9,177.86	64 04
7	49.61	1,637	440	310	223	60	80	959 75	630.38	131.65	4,471.78	90 14
8	78.64	6,900	1,000	1,879	400	1,100	250	654.40	547.05	351.45	13,081 90	166 30
9	147.67	9,945	1,490	2,060	95	500	110	1,804.00	1,267.10	1,297.23	18,369 33	124 32
10	100.00	7,100	1,215	1,525	590	1,770	300	1,496.50	645.10	274.75	14,916.35	149.17
11	186.71	15,001	1,525	1,225	630	. . .	290	2,9a2.00	1,313.34	1,203 52	24,129 86	129.24
12	156.97	7,870	3,830	1,800	395	1,830	275	2,516.75	788.75	653.00	19,958.50	127 15
13	198.25	9,228	2,260	2,850	1,130	680	350	2,438.55	980.25	1,390.60	21,297.40	107.43
14	388 92	23,335	1,720	1,585	890	345	157	3,936.70	1,115.45	1,478.40	34,562.55	88.87
15	219.82	9,650	930	900	900	135	125	1,975.65	679 90	609.55	15,805.10	71.90
16	172.52	7,930	825	720	625	.....	100	1,286 50	679.40	527 70	12,693.60	73.58
17	275.99	17,910	1,225	2,900	1,070	220	135	3,450.00	1,024.00	275.25	28,209 25	102 21
18	207.83	11,740	3,277	1,843	315	345	150	1,917 78	1,054 67	1,009.75	21,642 20	104.14
19	103.81	4,170	2,370	1,020	400	300	70	2,550.00	731.55	926 90	12,538.45	80.22
20	185 25	8,145	2,235	1,150	660	.....	50	2,883.75	556.10	817.80	16,497.65	89.05
21	228.62	5,090	724	1,726	700	.....	550	1,362.50	807.90	369 95	11,330.35	49 56
22	156.00	3,985	1,060	1,500	365	.....	70	1,281.50	346.60	285.25	8,893 35	57 01
23	177 27	5,245	580	1,570	720	.....	285	1,774.00	683.10	804.70	11,661.80	65 78
24	148.38	2,910	100	800	250	.....	20	860.00	173.20	115.45	5,228.65	35.21
25	10.85	435	350	500	45	... .	20	238.15	156.20	10.10	1,754.45	124.43

Table IV shows the acre investment in the various classes of equipment for 30 farms. With the exception of Nos. 5 and 11, all those up to and including No. 23 have also been included in tables showing the division of investment by enterprises, hence they are separated in this table from those which are less complete. Nos. 5, 27, 28, and 30 had not been surveyed by the Station surveyor up to the time these data were compiled, hence the acreages are only approximate. In several cases, the value of improvements was not separated from that of the land for want of sufficient information.

The land value in these cases includes all permanent improvements not otherwise shown. These incomplete data are presented for comparison with the mean and average of the 21 farms. While the data for Nos. 24 and 25 were complete, they were excluded from the summary as not representative, the former because of the extremely low investment and the latter because of the low acreage.

A close study of the table will reveal striking differences in the investment per acre for different purposes. As a basis for comparing the individual farms, the mean and the average of data from 21 farms are both included. The mean is obtained by adding together the average figures per acre for the different farms and dividing by 21, while the average is secured by taking the total investment for all the farms and dividing by the total acreage of all the farms. The mean, then, is an average having the farm as a unit, while the average regards the acre as the unit. These two might vary widely, and the fact that they do not adds to the value of the table. In this study of farms, the mean is regarded as the more suggestive, since it takes into account the effect of the size of the farm upon the acre investment.

The range in investment per acre farm in buildings is seen to be from 67 cents on farm No. 24, where a very old barn and several equally old sheds, etc., constituted the building equipment, to $32.25 for farm No. 25, where the value of a small barn and poultry house is divided by a small acreage. The investment varies with the condition and number of buildings, but the number and cost do not vary with the acreage.

Farms Nos. 13 to 17 are similar in character and location, yet the building equipment on farm No. 13 is $11.35 per acre, while on Nos. 14 to 17, inclusive, the valuation does not reach $5 per acre on any farm. This is due to the fact that Farm No. 13 is really composed of three farms formerly separate. On the other hand, farms Nos. 3, 5, 12, 18, 19, and 28, ranging in size from 103 to 342 acres, show an investment in farm buildings of $15.78 to $26.85 per acre, while Nos. 7, 8, 10, and 30, varying in size from 49.61 to 100 acres, have an investment in farm buildings of but $6.33 to $12.70 per acre.

TABLE IV. AVERAGE INVESTMENT PER ACRE IN LAND, IMPROVEMENTS AND PERSONAL FARM PROPERTY ON EACH OF 30 OHIO FARMS, WITH THE MEAN AND THE AVERAGE INVESTMENT PER ACRE FOR A GROUP OF 21 OF THESE FARMS

Farm No.	Acres	Land	Farm buildings	Household buildings	Fences	Drainage	Water supply	Livestock	Machinery, etc.	Produce, supplies, etc.
1	116.20	$61.62	$ 8.32	$12.91	$2.11	$ .39	$ .43	$10.89	$ 5.74	$1 90
2	164.11	19.53	6.09	4.88	1.52	.52	.37	10.06	3.80	3.17
3	104.25	41.44	26.85	23.98	4.37	2.40	.96	13.08	6.37	6.45
4	108.34	31.15	12.96	6.46	2.96	.28	1.57	12.33	6.30	3.04
6	143.32	24.18	6.29	6.29	3.94	....	1.19	12.32	7.58	2.26
7	49.61	33.00	8.87	6.25	4.50	1.21	1.61	19.35	12.70	2.65
8	78.64	87.74	12.70	23.90	5.08	13.98	3.17	8.31	6.94	4.48
9	147.67	65.99	10.08	13.93	.64	3.38	.74	12.20	8.56	8.80
10	100.00	71.00	12.15	15.25	5.90	17.70	3.00	14.97	6.45	2.75
12	156.97	50.14	24.40	11.46	2.52	11.66	1.75	16.02	5.03	4.17
13	198.25	46.55	11.35	14.38	5.69	3.43	1.77	12.30	4.95	7.01
14	388.92	60.00	4.43	4.07	2.29	.89	.40	10.11	2.87	3.80
15	219.82	43.90	4.23	4.09	3.65	.61	.57	8.99	3.09	2.77
16	172.52	45.97	4.78	4.17	3.62	....	.58	7.46	3.94	3.06
17	275.99	64.89	4.44	10.51	3.88	.79	.49	12.50	3.71	1.00
18	207.83	56.49	15.78	8.86	1.52	1.66	.72	9.24	5.02	4.85
19	103.81	40.17	22.81	9.81	3.86	2.89	.68	24.58	7.05	8.93
20	185.25	43.97	12.07	6.20	3.56	....	.27	15.57	3.00	4.41
21	228.62	22.26	3.16	7.55	3.06	....	2.40	5.95	3.54	1.64
22	156.00	25.55	6.79	9.62	2.35	...	.44	8.21	2.22	1.83
23	177.27	29.59	3.27	8.86	4.06	....	1.60	10.01	3.85	4.54
Mean of 21 farms	165.88	45.96	10.59	10.16	3.39	2.94	1.18	12.12	5.36	3.97
Average of 21 farms	165.88	46.25	9.27	9.11	3.22	2.21	1.04	11.40	4.67	3.81
State average (Cen. 1900)	88.50	33.37	8.96	.....	....	....	....	5.14	1.49	....
5	342.00	27.98	18.29	17.87	3.66	8.17	2.04	10.38	3.14	5.68
11	186.71	80.34	8.17	6.56	3.38	..	1.55	15.76	7.06	6.44
26	166.86	65.00	.....	.....	....	. ..	....	7.53	4.51	1.38
27	180.00	69.98	9.30	10.16	....	....	....	11.95	3.60	2.45
28	504.00	70.00	17.11	6.55	....	. ..	.. .	24.12	7.56	4.73
29	156.00	76.92	7.20	15.88	....	....	....	9.30	7.19	4.02
24	148.38	19.61	.67	5.39	1.68	....	.14	5.78	1.17	.78
25	10.85	40.10	32.25	46.09	4.15	. ..	1.84	21.95	14.39	.93
30	79.00	48.04	6.33	31.64	1.46	.. .	1.14	13.20	6.13	2.84

In household buildings there is a variation of from $4.07 to $46.09 per acre. Taking the 21 farms as a whole, there is practically the same investment in farm and household buildings, viz., $10.59 and $10.16 respectively, but among the 30 farms there are wide extremes represented. Farms Nos. 4, 12, 18, 19, 20, and 28 show from two to three times as great an acre investment ($12.07 to $24.40) in farm buildings as in household building ($6.20 to $11.40) while on Farms Nos. 8, 21, 23, 24, 29, and 30 the investment in household buildings ($5.39 to $31.64) is from two to five times as great as in farm buildings($3.16 to $12.70 per acre).

No particular need is apparent for such a wide variation in practice, and on a number of the most successful farms the investment in household and farm buildings is about equal. On Farm No. 24 with a farm building investment of $0.67 per acre and household building investment of $5.39 per acre, a new barn was to be erected within a year or two which would bring about nearly the same relative condition as exists on Farm No. 18, on which a $3,000 barn had just been completed and on which the farm and household building investments were $15.78 and $8.86 per acre respectively. The owner of Farm No. 30 moved from the city only a few years ago and invested the greater part of his ready capital in remodeling the dwelling. His percentage of total investment represented by the household building is much higher than that of any other farm except the small truck and poultry farm, No. 25, and even slightly exceeds the figure for that one. He spoke of the lack of certain essential machinery which was directly due to the excessive outlay in household buildings and conveniences.

New buildings for either household or farm use tend of course to vary the relation, as does also the presence of tenant houses, which are classed with household buildings, yet the few farms studied would indicate that the investment in buildings for both purposes should be approximately equal for farms of the general class.

A large part of Farm No. 9, with an investment for fencing of only 64 cents per acre, is unfenced, and on several others a large extent of rail fence accounts for a low investment per acre. Attention is called to Farms Nos. 7 and 8 with fencing investments of $4.50 and $5.08 per acre respectively, on which the proportion of road fence is particularly large. No. 13 has considerable road fence, but the high investment ($5.69 per acre) is largely due to the recent construction of woven wire fences and the generally good condition of those previously installed.

The acre investment in tile drainage and water supply depends largely upon the natural advantages of the farm. The extremes are, for drainage, 28 cents on Farm No. 4, and $17.70 on Farm

No. 10, the average being $2.21. The extremes for water supply are 37 cents on Farm No. 2, and $3.17 on Farm No. 8, with average of $1.04 for the 21 farms. Farms Nos. 8 and 10 have a high investment in all improvements and are the two highest in the amount invested in tile drainage, $13.98 and $17.70 per acre respectively, yet they show the highest bare land values, $87.74 and $71.00 per acre respectively. Both are connected with town by good stone roads, but the thorough drainage undoubtedly is a large factor in maintaining the value of the land.

The small acreage of Farms Nos. 7 and 25, 49.61 and 10.85 respectively, make the acre investment in water systems large, even though the systems are not extensive. Farms Nos. 8, 21, and 23 with an acre valuation for water supply of $3.17, $2.40 and $1.60 respectively, have more or less extensive water conveniences in the dwellings. Nos. 21 and 23 with investments of $2.40 and $1.60 per acre respectively for water, are to be contrasted with Nos. 18, 19, 20, and 22 with the respective valuations of 72 cents, 68 cents, 27 cents, and 44 cents, which are also in what is known as the hill section, hence able to easily obtain water from springs, but have not extended the water conveniences to the dwellings. Gasoline engines used only for pumping add to the investment on Farms Nos. 10, 12, and 13 with the acre valuation for water supply of $3.00, $1.75, and $1.77 per acre respectively.

The livestock inventory, like that of produce, supplies, etc., should be taken on the same date for all farms in order to be comparable. This is brought out strikingly by the case of Farm No. 12. The inventory in 1908 showed $1,700 worth of steers on hand, or nearly $11 per acre for this class of stock alone. Several days previous to the 1909 inventory, 39 head were sold, hence this farm, which is usually heavily stocked with cattle, shows a lower acre investment ($16.02) than its average for the year. The inventory of livestock, even if taken on the same date each year for all farms would not show the average investment accurately, as on some farms feeding stock are purchased, fed and marketed between succeeding dates of inventory. This would entail the investment of a considerable amount of capital for the greater part of the year which would not be apparent in a study of inventories. The study of investment in live stock can best be made in connection with Table VIII, which shows the relative importance of the various livestock enterprises.

With the exception of Farm No. 22 (acre valuation $2.22) for which much of the machinery was borrowed, No. 24 (acre valuation $1.17), for which it was generally bought second hand, and Nos. 7 and 25, with valuation of $12.70 and 14.39, which are low in acreage,

the acre investment in machinery, wagons, harness, tools, etc., ranges within comparatively narrow limits, this being from $2.87 on Farm No. 13 to $7.56 on Farm No. 28. With the exception of Nos. 22, 24, 25, and 28 the total machinery investment per farm is seen by reference to Table III to vary only about 136 per cent, as compared for instance, to 1,275 percent for the total value of farm buildings and 835 percent for household buildings. Two large farms, Nos. 5 and 14, containing 342 and 388.92 acres respectively, show low acre investments in machinery, i. e., $3.14 and $2.87 respectively, while the largest Farm No. 28, containing 504 acres, ranks among the highest, showing an acre investment of $7.56 and indicating over-equipment.

TABLE V. TOTAL AND PERCENTAGE OF TOTAL INVESTMENT IN REAL AND PERSONAL PROPERTY FOR EACH OF 30 OHIO FARMS, WITH THE MEAN AND AVERAGE FOR 21 OF THESE FARMS

Farm No.	Acres	Real Estate		Personal property		Total investment per acre
		Total	Percent	Total	Percent	
1	116.20	$ 86 28	82.30	$18 50	17.70	$104.81
2	164.11	32.91	65.90	17.03	34 10	49.94
3	104.25	100 00	79.40	25 90	20.00	125.90
4	108.34	55.38	71.80	21 67	28.20	77.05
6	143.32	41.88	65.70	22.16	34.60	64.04
7	49 61	55 44	61.50	34.70	38.50	90.14
8	78 64	146.57	88.10	19 73	11.90	166.30
9	147.67	94.76	76.20	29.56	23.80	124.32
10	100.00	125.00	83.70	24.17	16.30	149.17
12	156.97	101.93	80.20	25.22	19.80	127.15
13	198.25	83.17	77 40	24.26	22 60	107.43
14	388.92	72.09	81.10	16.78	18.90	88.87
15	219.82	57.05	79.40	14.85	20 60	71.90
16	172.52	59.12	80.30	14.46	19.70	73.58
17	275.99	85 00	83.30	17.21	16 70	102.21
18	207.83	85.03	81.60	19 11	18.40	104.14
19	103.81	80.22	66.40	40 65	33 60	120.78
20	185.25	66.07	74.20	22.98	25 80	89.05
21	228.62	38.43	77 50	11.13	22 50	49.56
22	156.00	44.75	78.50	12.26	21.50	57.01
23	177.27	47.38	72.00	18.40	28.00	65.78
Mean of 21 farms	165.88	74.22	77.60	21.45	22.40	95.67
Average of 21 farms	165.88	72.10	78.14	18 88	21.86	90.98
State average (Census 1900)	88.50	42.33	86.50	6.63	13.50	48.96
5	342.00	78.01	80.30	19.17	19.70	97.18
11	186.71	100.00	77.40	29.24	22.60	129.24
26	156.86	65.00	82 90	13.42	17.10	78.42
27	180.00	90.00	83.30	18 00	16.70	108.00
28	504.00	93.66	72.00	36.41	28.00	130.07
29	156.00	100.00	83.00	20.51	17.00	120.51
24	148.38	27.48	78.00	7.73	22.00	35.21
25	10.85	124.43	77.00	37.27	23 00	161.70
30	79.00	88.61	80.00	22.17	20.00	110.78

The total and percentage of investment per acre in real and personal property is given in Table V, together with the mean and average for the 21 farms. The odd cents shown in the values of the real estate are due to the fractional parts of an acre in the farm areas, these usually being disregarded by the farm owners. The land with improvements is seen to range from $27.48 to $146.57 per acre, though nearly all farms are valued considerably higher than the State average as shown by the twelfth census. viz., $42.33 per

acre. The amount of personal property per acre, $7.73 to $40.65, is higher than the State average, $6.63, in every case. It is to be remembered, however, that for comparison the value of produce, etc., is to be deducted from that of the personal property shown, the census values including only livestock and machinery. Excluding produce, etc., the average of the 21 farms shows 81.4 percent of the total farm value in real estate, and 18.6 percent in personal property as compared with 86.5 percent and13.5 percent, respectively, for the State. The greater value of personal property on these farms argues the correctness of the statement previously made that the farms under consideration are more successful than the average.

Including produce, etc., a mean of the 30 farms shows 77.34 percent of the total inventory value to be due to land and improvements. The mean of the 21 shows 77.6 percent in real estate and the average, 78.14 percent. Seventeen out of 30 farms range between 77 percent and 83 percent in real estate, these having a mean of 79.8 percent. These figures should serve as an indication of approximately the proper division of equipment capital on farms of this class, the cash and other assets, of course, not being considered in this study.

The percentage of the total investment represented by each class of equipment is given in Table VI. The uniformity in the percentage of value in land on Farms Nos. 14 to 17, viz., 67.52, 61.10, 62.46, and 63.49, respectively, and Nos. 20 to 23, viz., 49.36, 44.90, 44.80, and 45.00, respectively, is interesting. The former are large level farms in the southwestern quarter of the state and the latter are large hill farms in the southeastern quarter. The influence of size of farm is to be seen in Farms Nos. 7 and 25, and of large building equipment on several others already noted.

The average land value for the state should be compared with the total for land and all improvements except buildings on the 21 farms. The mean of the 21 farms shows 55.9 percent and the average 57.9 percent in land, fences, drainage, and water supply as compared to 68.1 percent for the State. The mean shows 21.7 percent and the average 20.2 percent in all buildings as against 18.4 percent for the State. Both percentages for the State would be lowered if produce, etc., had been included in the census. The percentage invested in fences varies even more widely than the acre investment, while the percentages in drainage and water supply usually vary with the natural features of the farm. Farms Nos. 5, 8, 10, and 12 with percentages of 8.41, 8.39, 11.87, and 9.18 respectively in drainage, have been tile drained over the greater part of their areas. A large part of the investment in water supply on Farm No. 21 is chargeable to household.

TABLE VI. THE PERCENTAGE OF THE TOTAL INVESTMENT REPRESENTED BY EACH CLASS OF EQUIPMENT ON 30 OHIO FARMS, WITH MEAN AND AVERAGE PERCENTAGES ON 21 FARMS

Farm No.	Acres	Land	Farm buildings	House-hold buildings	Fences	Drainage	Water supply	Livestock	Machin-ery, etc	Produce, supplies, etc.
1	116.20	58.79	8.42	12.31	2.01	.37	.41	10.39	5.48	1.82
2	164.11	39.12	12.20	9.74	3.05	1.04	.73	20.16	7.62	6.35
3	104.25	32.90	21.35	19.05	3.46	1.91	.76	10.39	5.06	5.12
4	108.34	40.42	16.64	8.29	3.84	.36	2.04	16.01	8.17	3.94
6	143.32	37.74	9.78	9.78	6.25	....	1.85	19.25	11.82	3.51
7	49.61	36.60	9.85	6.93	4.99	1.34	1.79	21.46	14.10	2.94
8	78.64	52.72	7.64	14.36	3.05	8.39	1.90	5.00	4.17	2.77
9	147.67	53.06	8.11	11.21	.52	2.72	.60	9.82	6.89	7.07
10	100.00	47.60	8.15	10.23	3.95	11.87	2.01	10.03	4.32	1.84
12	156.97	39.42	19.18	9.02	1.98	9.18	1.38	12.60	3.96	3.28
13	198.25	43.35	10.55	13.39	5.30	3.20	1.64	11.44	4.60	6.53
14	388.92	67.52	4.97	4.58	2.58	1.00	.45	11.40	3.22	4.28
15	219 82	61.10	5.89	5.70	5.06	.80	.79	12.50	4.30	3.86
16	172 52	62.46	6.50	5.67	4.95	....	.79	10.12	5.35	4.16
17	275.99	63.49	4.34	10.29	3.80	.78	.48	12.23	3.62	.97
18	207.83	54.24	15.14	8.51	1.46	1.59	.69	8.86	4.84	4.67
19	103.81	33.20	18.90	8.10	3.20	2.40	.60	20.30	5.90	7.40
20	185.25	49.36	13.55	6.97	4.00	....	.30	17.48	3.37	4.97
21	228.62	44.90	6.38	15.22	6 20	....	4.90	12.00	7.10	3.30
22	156.00	44.80	11.91	16.89	4.10	....	.80	14.40	3.90	3.20
23	177.27	45.00	4.97	13.46	6.18	....	2.42	15.21	5.86	6.90
Mean of 21 farms	165.88	48.04	11.08	10.61	3.54	3.07	1.23	12.68	5.60	4.15
Average of 21 farms	165.88	50.82	10.20	10.01	3.54	2.43	1.14	12.54	5.13	4.19
State Av. (Census 1900)	88.50	68.14	18.36	.....	....	....	....	10.48	3.02	....
5	342.00	28.80	18.80	8.39	3.78	8.41	2.10	10.68	3.20	5.84
11	186.71	62.15	6.32	5.08	2.61	. ..	1.20	12.20	5.45	4.99
26	156.86	82.90	.....	.....	....	....	....	9.60	6.74	1.76
27	180.00	65.35	8.62	9.38	....	....	....	11.04	3.34	2.27
28	504.00	53.80	13.16	5.04	....	....	....	18.60	5.80	3.60
29	156.00	63.80	6.00	13.20	....	....	....	7.72	5.96	3.32
24	148.38	55.65	1.91	17.22	4.78	....	.38	16.45	3.31	2.21
25	10.85	24.79	19.95	28.50	2.56	....	1.14	13.58	8.90	....
30	79.00	43.38	5.71	28.56	1.31	....	1.03	11.92	5.53	....

The percentage invested in livestock is within the limits of 10 and 20 percent, except in a very few cases. On Farm No. 8, with a livestock investment of 5 percent, there are a low acre investment in livestock ($8.31 as against an average of $11.40) and a high land value ($87.74 as against an average of $46.25) to explain the low percentage. The farm is owned by a man who has limited his farming operations with advancing age. The percentages invested in livestock and machinery as shown by the inventories are lower than they would be on a basis strictly comparable with the State average, as the 4 or more percent in produce, etc., is included in this study and not in the census data. The average percentages for the 21 farms, with the last item omitted, would be as follows: Land and all improvements except buildings, 60.4; buildings, 21.1; livestock, 13.1; machinery, 5.4. The values placed on livestock and machinery were probably on a higher basis in these inventories than census valuations, and all prices were undoubtedly higher than in 1900, hence the comparison with the State averages is of less value than would at first appear. Farm No. 6, with a percentage of 11.82 in machinery, has equipment for manufacturing butter and maple sugar in addition to the ordinary machinery, and No. 7, a small farm with a percentage investment in equipment of 14.10, has a portable gasoline engine and wood sawing outfit, only a part of which possibly should have been charged to the farm. Aside from these two cases the variation of the percentage invested in machinery is small as compared with other classes of equipment.

DISTRIBUTION OF INVESTMENT BY ENTERPRISES

Reference has already been made to the division of investment by enterprises. Table VII shows the average distribution of capital for the 21 farms, on the basis previously set forth.

It will be noted that the land value is divided on the basis of acreage, no differences in quality of land on the same farm being recognized. This suggests that a farm inventory be made to show the relative value of the various kinds of land, as, for instance, waste, dooryard, pasture, barn lots, crop land, orchard and woodland. The crop land is included in one item under "All Crops," owing to the annual variation in acreage for the different crops.

The division of building values, based on the cubic space occupied by different enterprises, seems out of proportion, emphasizing, as it does, the much larger amount of space occupied in proportion to the value of property in the case of produce, supplies, etc., ($766.57) in storage than in the case of livestock ($436.51). The "produce and supplies" item under "buildings" might be divided between "All Stock" and "All Crops," but for the annual variation in the proportion of products fed and sold. The "All Stock" building charge is based on space devoted to sheds, alleys, etc., used by or used in caring for all or at least several classes of

stock. Buildings wholly or partially devoted to work shops or to the storage of machinery, wagons and tools give rise to the amount charged to "General Farm" ($325.42). A potato storage house and several sap houses were found. "Buildings" include both household and farm buildings.

The machinery and utensils charged to household ($11.07) were those which in some cases might be used either for domestic or farm purposes. Each class of livestock is charged with the articles pertaining directly to it, also each crop enterprise. Vehicles for transportation and a large proportion of the smaller tools are charged to "General Farm" ($237.29), and plows, harrows and other general crop machinery are charged to "All Crops" ($102.71).

In Table VIII are given by enterprises the percentages of total investment for 25 farms, together with the mean of the percentages for the 21 individual farms and the average percentages for the 21 farms considered as a unit. Miscellaneous enterprises are grouped under the column so headed. These include Maple Sugar, Syrup, etc., on Farms Nos. 1, 2, 5, 6, and 17; Orchard on Farms Nos. 3, 21, 22, and 23; Sugar Beets on No. 10; Tobacco on No. 24; and Market Garden on No. 25. On No. 4, 8.65 percent is invested in the Maple Sugar enterprise and 1.68 percent in Orchard; on No. 18, 0.28 percent is in Sugar and 0.92 percent in Orchard. Bees, also included with miscellaneous enterprises, average 0.03 percent of the total, amounting to less than 0.4 percent on any farm represented in Table VIII. On Farm No. 29, however, this enterprise represents 2.51 percent of the total investment.

The relative importance of the various live stock enterprises can readily be ascertained from Tables VII and VIII. On high priced land the "All Crop" enterprise naturally bears a higher proportion of the total investment. The investment in special crop machinery is relatively small. The low figures (.15, .10, .07, and .21) for corn machinery among the "hill" farms (Nos. 20 to 23, inclusive) are to be noted.

The distribution of capital for each farm is worthy of consideration by itself. It is not easy to generalize in this connection, all the factors discussed up to this point governing the selection of equipment. From the various tables, and especially from Table VIII, will be seen the difficulty of studying the farm as a unit instead of the enterprise. Farms Nos. 1, 2, 6, 9, 21, and 23 might be classed as dairy farms, yet the relative investment in various enterprises is far from uniform. With the exception of these, and Farms Nos. 20 and 25, the farms studied can best be classed as "general", and among these occur variations in the relative investment to understand which an analysis of the farm as a combination of enterprises is essential.

TABLE VII. AVERAGE INVENTORY OF 21 OHIO FARMS, SHOWING THE DISTRIBUTION OF INVESTMENT BY CLASSES OF EQUIPMENT, AND BY ENTERPRISE

Enterprise	Acres	Value of land	Buildings	Fences	Drainage	Water supply	Livestock	Machinery, etc.	Produce, supplies, etc.	Total	Percent
General farm	5.51	$ 246.44	$ 325.42	$533.95	$ 1.09	.....	.....	$237.29	.. ...	$1,344.19	8.90
Household	2.04	91.01	1,437.05	.....	.71	$ 72.48	.....	11.07	.....	1,612.33	10.70
Labor	.08	3.91	74.29	.....	.....	1.19	.....	.....	.....	79.39	.53
Produce, supplies, etc.	. ..	.....	766.57	.....	.....	.....	.....	.....	$631.93	1,398.50	9.26
Horses	....	.....	77.85	.....	.....	28.52	$ 891.66	77.46	.....	1,075.51	7.13
Cattle	....	.....	153.74	.....	.....	37.86	582.26	32.48	.....	806.35	5.34
Sheep	....	.....	65.50	.....	.....	10.81	201.05	3.06	.....	280.42	1.86
Hogs	....	.....	34.70	.....	.....	16.38	158.34	12.17	.....	221.59	1.46
Poultry	....	.....	40.83	.....	.....	4.53	52.60	4.89	.....	102.85	.68
Bees	....	.....	.....	.....	.....	.....	3.23	1.59	.....	4.82	.03
All stock	46.50	2,037.10	63.89	.....	2.14	.....	.....	10.59	.....	2,113.72	14.00
All crops	85.71	4,157.92	.....	.....	362.48	.....	.....	102.71	.....	4,623.11	30.63
Corn	....	.....	.....	.....	.....	. ....	.....	83.38	.....	83.38	.56
Small grain	....	.....	.....	.....	.....	.....	.....	70.98	.....	70.98	.47
Hay	....	.....	.....	.....	.....	.....	.....	65.83	.....	65.83	.44
Potatoes	....	....	3.57	.....	.....	.....	.....	20.44	.....	24.01	.16
Sugar	2.98	122.27	6.05	.....	.....	.....	.....	35.36	.....	163.68	1.08
Orchard	1.95	69.39	.....	.....	.....	.....	.....	4.00	.....	73.39	.49
Woodland	21.11	948.39	.....	.....	.....	.....	.....	.....	.....	948.39	6.28
Beets	....	.....	.....	.....	.....	.....	.....	.59	.....	.59	.004
Total	165.88	7,676.42	3,049.47	533.95	366.43	171.76	1,889.15	773.92	631.93	15,093.03	.....
Percent	....	50.82	20.21	3.54	2.43	1.14	12.54	4.67	4.19	. .....	100.00

TABLE VIII. PERCENTAGE OF TOTAL FARM CAPITAL INVESTED IN EACH ENTERPRISE ON 25 OHIO FARMS, WITH MEAN AND AVERAGE PERCENTAGES FOR A GROUP OF 21 OF THESE FARMS

Farm No.	General farm	House-hold	Labor	Stor-age	Horses	Cattle and dairy	Sheep	Hogs	Poul-try	Bees	All stock	All crops	Corn	Small grain	Hay	Pota-toes	Misc.	Wood-land
1	4.47	13.00	....	5.88	1.76	11.86	....	1.07	.52	....	28.65	18.76	.60	.37	.23	....	1.64	11.19
2	10.01	10.70	....	9.50	7.86	16.40	....	.87	.88	....	13.54	19.15	.54	.49	.88	.38	.40	8.40
3	9.02	20.20	....	16.90	10.27	1.25	4.36	.08	.83	....	7.25	19.38	.29	.63	.37	.02	4.78	4.36
4	11.73	9.78	....	11.01	7.85	13.20	....	1.25	.61	....	9.91	22.25	.42	.47	.75	.07	10.33	....
6	13.60	12.11	....	7.87	13.08	8.10	....	.99	1.73	....	9.90	21.30	.61	1.65	1.01	.97	7.70	.28
7	19.15	8.89	....	7.72	17.65	3.20	2.96	.97	1.72	.39	14.32	17.55	.45	.01	.59	1.43	.....	3.00
8	8.83	16.45	....	6.75	3.34	1.53	....	3.61	.63	....	11.10	47.19	.13	.10	.66	.01	.....	.67
9	6.03	9.50	2.74	10.36	3.95	7.65	....	1.36	.33	....	11.60	33.19	1.49	.74	.31	1.42	....	9.33
10	9.36	12.00	....	7.16	7.19	3.06	1.02	.48	1.33	....	2.50	52.50	.10	.38	.61	.31	.08	1.92
12	7.20	9.81	....	15.21	11.29	3.48	....	2.18	.47	.04	7.64	35.92	.93	.53	.28	....	.....	5.02
13	9.40	15.00	....	12.85	8.53	3.04	1.17	1.51	.93	....	7.89	34.82	.36	.52	.41	.07	.....	3.50
14	6.64	5.31	....	6.85	6.22	4.37	.24	2.19	.14	.02	21.31	35.76	.52	.39	.20	....	.....	9.84
15	8.18	7.00	....	7.08	7.64	3.96	....	2.44	1.02	....	19.23	37.35	1.19	.59	.12	....	.....	4.20
16	9.55	6.63	....	6.63	9.04	1.42	.88	1.81	.39	...	4.35	42.96	1.61	.63	.21	....	.....	14.22
17	7.73	9.75	1.55	2.96	3.57	7.24	2.83	....	.42	.01	19.95	30.07	.37	.38	.20	....	6.07	6.90
18	8.50	9.22	....	12.02	3.46	1.21	4.79	3.70	.52	....	7.60	34.40	.50	.44	.70	....	1.22	11.69
19	8.80	8.80	....	17.40	11.10	11.60	....	1.80	.90	....	9.20	25.80	.50	.40	.90	.30	.....	2.50
20	11.17	4.38	3.10	10.62	7.92	1.15	11.75	....	.42	.26	23.37	22.62	.15	.20	.56	.26	.....	2.06
21	13.92	16.29	1.91	6.33	6.42	7.18	3.08	1.12	.59	.02	12.50	13.74	.10	.39	.38	.06	.94	15.01
22	8.28	17.90	....	7.32	8.73	4.51	5.27	....	1.98	.12	31.07	9.31	.07	.08	.44	....	.97	3.95
23	12.20	15.36	....	8.57	8.15	9.44	....	1.03	.72	.09	17.52	20.52	.21	.53	.55	.26	2.78	2.07
Average of 21 farms	8.90	10.70	.53	9.26	7.13	5.34	1.86	1.46	.68	.03	14.00	30.63	.56	.47	.44	.16	1.57	6.28
Mean av. of 21 farms	9.70	11.337	.443	9.365	7.85	5.945	1.827	1.354	.813	.045	13.780	28.325	.53	.472	.49[3]	.264	1.759	5.719
24	7.70	16.05	.. .	3.12	11.00	3.40	1.72	1.05	.66	.13	17.60	27.60	.38	.43	.12	....	.47	8.60
25	12.40	29.57	....	.58	9.50	3.36	....	..	19.43	....	.96	23.13	.14	.29	....	....	.64	....
5	8.74	18.56	1.12	16.02	6.04	4.49	5.59	.57	.47	....	11.65	19.04	.45	.27	.39	.02	.35	6.23
11	7.49	5.95	....	6.81	6.59	4.52	3.53	1.19	.75	....	4.70	46.00	.73	.63	.35	....	.77	9.99

EQUIPMENT OF THE AVERAGE FARM

In the foregoing pages the distribution of capital at the time of inventory has been discussed. The next phase of the study, and really the first in order, is the enumeration of the items that go to make up the equipment of an average farm. The average equipment of the 21 farms which have been studied will, of course, apply only to farms having approximately the same conditions as this "average farm." The various classes of equipment will be dealt with separately in the following pages and sufficient detail given to permit the application of the data to farms diverging from the type under consideration. It is impossible to make a general recommendation as to equipment owing to the complex and varying combinations of enterprises on different farms, and the summary presented later is valuable in a suggestive way only.

REAL ESTATE

The average value previously shown for the bare land is taken as a basis instead of the mean, as all other data relating to the first cost of equipment are based on averages. The cost and present value of drainage systems were regarded as equal, as before stated, but the first cost of buildings, fences, and water supply will be higher than the values shown in the previous pages. The various improvements will be discussed separately.

HOUSEHOLD BUILDINGS

The great variation in the tastes and circumstances of different farm owners is largely responsible for the variation in the cost of household buildings, and it is almost impossible to arrive at a satisfactory basis for determining the proper outlay in this direction.

It has been shown (Table VII) that on the 21 farms studied the inventory value of household and tenant buildings was approximately equal to that of farm buildings, each being about $1500. This, however, does not represent the present cost of construction. Household buildings were not studied closely as to size and cost, but from the values shown in Table III,and such data as are at hand it is estimated that to replace those found on the 21 farms would involve an expenditure of from $600 to $4000 per farm averaging close to $2500. This would include dwellings for proprietors, tenants, or laborers, wood houses, smoke houses, and milk cellars, ice houses, etc., which might also be used to some extent for the farm.

SPACE NEEDED IN FARM BUILDINGS

The farm buildings must usually provide for the shelter of horses, cattle, sheep, hogs, and poultry, and for a certain amount of space to be used by or devoted to the care of several classes of livestock. They must usually accommodate all or a large part of the products of the farm fields, including roughage, grain, and seed.

They should provide space for the storage of all wagons, machinery and tools, and for the farm workshop. A certain amount of easily accessible space should be available also for convenience in the temporary shelter of machinery, livestock, or products. Buildings for special purposes, such as the storage of root crops and ensilage, and the manufacture of maple products, are necessities on only a part of the farms.

In studying this problem the size and plan of each building was noted, together with the enterprise to which each portion of the building was devoted at the time. The amount of floor and cubic space devoted to the various enterprises has thus been approximated. (The thickness of walls and partitions was not considered.) While averages of the 21 farms do not include enough cases to justify the drawing of general conclusions, the data contained in Tables IX and X afford a rough working basis.

In Table IX are included data concerning enterprises the space for which depends to a considerable extent upon the size of the farm. Under "General Farm" is included all space devoted to machinery storage, work shop, driveways, and other spaces devoted to the farm as a whole. "Hay Storage" includes the area and volume of mows and lofts. The volume, in this case, is greater than the space ordinarily filled with hay or other roughage. The proportion of the entire volume of mows which could actually be filled by the ordinary methods could not be satisfactorily determined at the time, and the space usually filled was extremely variable, hence the total volume was used in this table. "Grain Storage" includes separate cribs and granaries, also all bins and storage places for grain and seed in other buildings.

TABLE IX—AVERAGE FLOOR AND CUBIC SPACE DEVOTED TO THE STORAGE OF PRODUCTS, MACHINERY, ETC., IN BUILDINGS ON 21 FARMS

Enterprise	Average Space per farm		Average Space per acre		Average Space per acre of crops	
	Floor	Cubic	Floor	Cubic	Floor	Cubic
General Farm ..	2,038	24,732	12 3	149 0	23 7	288.5
Hay Storage.....	2,752	46,558	16 5	280 6	32.1	543 2
Grain Storage	505	5,192	3 0	31 3	5 8	60 5

The average space per acre shown in Table IX would tend to increase with a decrease in the size of farm and vice versa. On the smaller farms the amount of waste space would be greater for each enterprise and the space devoted to certain general farm purposes would remain practically the same as for the larger farms.

In Table X are shown averages in connection with the space devoted to livestock enterprises. In order to obtain comparable units all young stock except colts was reduced to the basis of mature animals. Two head of young cattle, 2 shoats, or 5 pigs were regarded as equivalent to one mature animal. Since young lambs are later included with the ewes in Table XIII no correction was necessary. The space in harness rooms is included in that shown for horses, and space devoted to milk rooms, etc., in that shown for cattle. For sheep the space includes both floor and rack room, with very little waste. For swine the space shown includes feed alleys, etc., in hog houses. The average space per head is, of course, much too small for the entire herd of swine. Only 11 out of 21 farms show a definite space devoted to swine, and on the other farms swine usually occupy a portion of the "All Stock" space during part of the year. Portable houses for the brood sows are in quite common use. These, averaging 4.1 per farm, were included with the miscellaneous items of equipment rather than with permanent farm buildings.

TABLE X—AVERAGE FLOOR AND CUBIC SPACE PER FARM AND PER HEAD DEVOTED TO LIVESTOCK ENTERPRISES IN BUILDINGS ON 21 OHIO FARMS

Enterprise	Average No. of mature Animals per farm	Average Space per farm		Average Space per head	
		Floor	Cubic	Floor	Cubic
Horses	7	613	5242	87.5	748.8
Cattle	13	1084	9210	83.4	708.4
Sheep	41	475	4141	11.6	100.9
Swine	17	327	2912	19.2	171.3
All Stock	..	448	3925	....	.....

SIZE OF FARM BUILDINGS

It is possible to plan a practical set of farm buildings which will almost exactly fit the conditions of the "average farm" under consideration. The size and nature of the buildings must, of course, be varied to fit any individual conditions, but assuming that the data in Tables IX and X give the requirements for this particular size and type of farm, the size of the separate buildings is the next item to be determined.

BARN

Of the barns on the 21 farms about half were basement or "bank" barns, and in case of the greater number of the remainder the space equivalent to a basement was secured by attaching to the barn unsightly sheds of the "lean-to" type. In the majority of

cases there could be had a convenient site for a basement barn without excessive grading, and the advantages of this type are such that they will be provided for in the barn to be planned.

Horses, cattle, and sheep are often found in the basement of a barn. In this case a barn 36 ft.x60 ft. will provide 2,160 square feet of floor space (outside measurement), while the requirements for the three classes of stock total 2,172 square feet, these also being calculated on outside measurement. A section 16 ft. x 36 ft. at one end will provide 576 square feet for horses, and an additional space 4 ft. x 9 ft. for harness would utilize the average space allotted to this enterprise. The 16 feet would be reduced by the thickness of the wall, but would leave ample room for manger, stall, and alley behind the horses. The 7 horses could easily be accommodated in the width remaining after the thickness of one wall is deducted from 36 feet. As a rule, in barns of this kind, the basement wall is provided on three sides only, the two ends and the long side next the bank.

A section 30 ft.x36 ft. would provide 1,080 square feet for cattle where 1,084 are required. This would afford ample space for the average of nearly 8 cows per farm, for the young and miscellaneous stock, and for a milk room if considered advisable to place one there. It would afford room for the miscellaneous stock on a beef farm and feeding room for a small carload of steers. The sheep would preferably be lodged in the center space, in which the harness room and a stairway could be located. Deducting the area of the harness room from the remaining space, 14 ft. x 36 ft., there are left 468 square feet for sheep where 475 were needed. A height of 8 ft. 8 in. would supply 18720 cubic feet in the basement, while 18,593 cubic feet are required. In this plan both horses and cattle are provided with more and sheep with less cubic space than called for by the average. A basement somewhat similar to the one just described was found on farm No. 3.

The upper part of this barn is adapted from that of a barn 40 ft. x 60 ft. on farm No. 14. A central driveway 14 feet wide extends through the center of the barn, making a floor space 14 x 36 feet available for general farm purposes. To the left of the driveway is a staircase to the basement, the remainder of this end of the barn being devoted to hay storage. On the right of the driveway a grain room 10 ft. x 23 ft. and a space 26 ft. x 23 ft. for storage of wagons or machinery occupy the floor space. A mow floor extends over these spaces at a height of 8 ft., and over the driveway at a height of 12 ft. The barn is 18 ft. from the top of the basement wall to the corners, or to the "square," and a roof of ⅓ pitch gives an additional height of 12 ft. to the point of the gable. This provides 2,160 feet

of floor space for hay, and 230 for grain storage, though volume is rather the essential in this case. It provides 39,168 cu. ft. for hay and 1,840 cu. ft. for grain, leaving a balance to be provided for hay of 7,390 cu. ft., and for grain of 275 sq. ft. and 3,352 cu. ft. In the driveway 14 x 36 and storage space 26x23, an area of 1,102 sq. ft. and a volume of 10,832 cu. ft. are provided for general farm purposes, leaving a balance of 936 sq. ft. and 13,900 cu. ft. to be provided for by other buildings.

The cost of this barn will vary with many factors. This can more easily be estimated by the contractor than the necessary size, hence the latter point only was emphasized in this study. A study of costs of four comparatively new barns of similar type indicates that about 2½ cents per cubic foot enclosed will cover the cost of a barn of this size and type. It is a common practice among Ohio farmers who have timber available to utilize a considerable amount of lumber sawed upon the farm and the exact value of this is difficult to estimate. This barn contains 70,560 cubic feet and at the rate given it would cost close to $1,800, but this is probably a low estimate.

HAY BARN

Where a basement barn is not practicable there is usually a second building for the storage of hay and the shelter of a part of the live stock. In some cases this is made large enough so that sheds attached to the barns are dispensed with. In order to provide for the additional space required for "all stock" (448 square feet and 3925 cubic feet) and for the additional storage of hay, a building of this sort is here planned for the "average farm" supplemental to the above planned barn. To combine the cubic space required for both purposes with the floor space required by "all stock" would result in a building of unusual proportions, hence the ground area is increased from 448 to 512 feet as shown in Table X. A building 16 ft. x 32 ft., 16 ft. to the "square", with roof given one-half pitch will give an excess of 64 square feet and 171 cubic feet for "all stock." It will also provide 6144 cubic feet for the hay storage, as compared with the remaining requirements of 7390 cubic feet, if the second floor is placed 8 feet above ground. A further increase of floor space accompanied by a decrease in height would improve the proportions of the building, though they are not unusual. As this building may be of cheap construction $150 should cover the cost.

WAGON SHED, CRIB, ETC.

The grain room in the large barn failed to provide for a large part of the space required for grain storage. The ratio between floor and cubic space remaining suggests a high crib or granary.

A popular building is a double crib, or a combination of crib and granary, with a driveway between, which, when enclosed by doors at either end, may be used as a convenient wagon or buggy shed. A building 20 ft. x 28 ft. on the ground and 10 ft. in height, with an 8-foot gable, is suggested. Two cribs, each 5 ft. wide, and a driveway 10 ft. wide, all extending the length of the building, would occupy the floor space. For grain storage this building would provide 3,360 cubic and 280 square feet, or almost exactly the remaining balance of the required amount, i. e., 275 sq. ft. and 3,352 cubic feet. Including the loft above the driveway which could be used for the storage of light implements, ladders, etc., 3,920 cubic feet would be provided for general farm purposes and 280 square feet of ground space. This building, built with the average finish, would probably cost from $200 to $250.

MACHINERY SHED AND WORKSHOP

In the large barn planned and in the above combined wagon shed and crib there was provided an area of 1382 square feet and 14,752 cubic feet for general farm purposes. There still remain balances of 656 sq. ft. and 9,980 cubic feet to be devoted to these purposes, if the requirements as set forth in Table IX are complied with. The storage of a part of the farm machinery and the location of the farm workshop have not been provided for; hence, a building 22 feet by 30 feet, and 12 feet in height to the eaves is designed to meet these needs. If a workshop were finished off, the building would probably cost from $250 to $300.

HOG HOUSE

Only part of the farms have separate permanent hog houses. The average floor space devoted exclusively to hogs on the 21 farms was 327 feet. A house 12 ft. x 27 ft. would furnish this and provide for a 4-ft. feed alley the length of the building and 4 pens 8 ft. x 6¾ ft. With this building, several portable houses, and the occasional use of space in other buildings, the average herd shown in Table XIII viz., 1 boar, 6 brood sows, 22.1 shoats and 20.5 pigs could be accommodated. If the house were made 10 ft. high in front and 8 ft. in the back, with a shed roof, the average requirements as to cubic space would be met. The probable cost of the hog house would be from $60 to $100.

POULTRY HOUSE

Poultry houses on 5 farms besides the 21 which have been under discussion are considered in the following averages. The average flock on these farms was equivalent to 106 hens, or a trifle larger than on the 21 farms. The floor space per hen varied from 1½ to 11.7 square feet on different farms. Excluding the latter case the mean was 3.46 square feet per hen. The mean cubic space

per hen was 24.4 ft., indicating 7 feet as the average height of houses. In 40 percent of cases the area per hen was between 1½ and 2½ square feet; in about 40 percent of cases the area of the poultry house was between 150 and 250 square feet, and in 60 percent of cases the number of fowls kept in one house was between 60 and 120. In the remaining cases there was a wide variation. To house the 106 fowls at the mean rate of floor space per fowl would require an area of 367 sq. ft. of floor space, which would be provided approximately, by a house 12 ft. x 30 ft. Five square feet of floor space per hen is often recommended by poultry authorities, and 4 square feet per hen should be considered as a minimum in good farm practice but 60 percent of this area is apparently closer to actual conditions on most farms, and a house 12 ft. by 20 ft. is probably nearer the average than one 12 ft. x 30 ft. A house for the accommodation of the flock of average size should not be less in floor space than 12 ft. x 36 ft. or 16 ft. x 27 ft., or better still would be two houses 12 ft. x 20 ft. In this latter case the one-year-old fowls could be kept in the one house and the two-year-olds in the other and the difficulty of separating the old from the young would be obviated. The poultry had free range on practically all the farms. The poultry house would represent an outlay of from $50 to $75 on the average farm.

SILO

Silos are usually associated with the cattle enterprise. Six wooden silos of from 100 to 120 tons capacity were found, 4 in connection with dairy cattle and two with beef cattle. These cost from $150 to $250 in place, depending upon the size and material.

SAP HOUSE

Where a "sugar bush" is turned into revenue a separate building is usually found advisable. This often consists of a room for the evaporator, etc., and a woodshed. It is ordinarily built of old or rough lumber and as cheaply as possible. A building 18 ft. x 32 ft., 8ft. high, with roof given ⅓ pitch is close to the average of three sap houses found on these farms.

MISCELLANEOUS BUILDINGS

On many farms there are buildings for special purposes not already discussed. On farm No. 9 is a potato cellar costing about $75. On farm No. 29 there is a bee house for storing the bees, hives, etc., during the winter. An occasional well house is included under water supply. An investment of $75 per farm would probably be an average for silos, sap houses, and other farm buildings of a miscellaneous character, on the 21 farms.

SPACE UNITS IN FARM BUILDINGS

From the foregoing discussion it will be apparent that there is great need for definite space units to be used in the planning of farm buildings. The usual division of crops on the 21 farms studied makes it necessary to provide for storing the yields from 25 to 30 acres each of corn, small grain, and hay. Yields of 50 bushels of corn to the acre from 28 acres, 20 bushels of wheat from 14 acres, and 40 bushels of oats from 14 acres would require approximately 4,550 cubic feet of space, which is more than provided for on the average, since some of the corn is used for silage and some of the grain is sold immediately. Maximum yields, however, could encroach on the 'General Farm" space. A hay yield of 2½ tons to the acre from 28 acres would tax the capacity of the mows provided on the average farm (165.88 acres) and straw would ordinarily have to be stacked outside, especially if corn stover were shredded.

The units of space for field products are well understood, however, in comparison to those for livestock and general farm purposes. The averages presented are simply those of actual conditions on a small number of farms, and it is a matter of common observation that most farm buildings can not be regarded as models of economy and convenience. Units of space for each class of livestock, including the area occupied by the animal itself, the racks or mangers, alleys, and the feed of the animal, would be of great assistance in the planning of buildings for economy of space. These can not be worked out satisfactorily on theoretical grounds, but should be obtained from a careful study of the best farm practice.

FENCES

The study of the extent of fence on the 21 farms yielded some interesting data which are presented in Tables XI and XII. In Table XI are given the total rods of fence maintained by each farm, divided into outside or line fence, inside fence, and road fence. Only the total fence kept up by the owner is represented, hence the amount of line fence should be doubled in order to get the total number of rods touching the farm. The first cost of fence per acre is affected not only by the character of the fence but by the number of rods per acre. The effect of a large amount of road fence on the latter may be seen by contrasting farms Nos. 7 and 8, having 284.1 and 333.9 rods of road fence respectively, making the average rods per acre 13 and 10.4 respectively, with Nos. 1 and 2, which have 6.1 and 4.9 rods respectively of road fence. Under "road fence" is included river or other outside fence not shared by an adjacent owner. Naturally the smaller farms show a greater extent of fence per acre than the larger, but this is not necessarily

true in every case. The average of all the farms shows approximately one-half the fence inside, one-fourth on the road, and one-fourth between the farm and those adjacent. A slight discrepancy is shown between the acre value of fences in Tables IV and XI, as in the former the total value of fences on each farm was brought to a round number, while in the latter the actual value is used.

TABLE XI—TOTAL RODS OF LINE, ROAD AND DIVISION FENCE MAINTAINED BY THE OWNERS OF 21 OHIO FARMS, WITH COST, VALUE AND NUMBER OF RODS PER ACRE

Farm No.	Acres	Owner's share of line fence	Road fence	Inside fence	Total owner's fence	Cost of fence per acre	Value of fence per acre	Average rods per acre
		Rods	Rods	Rods	Rods			
1	116 20	365.8	11.9	330.	707.7	$ 2.49	$ 2.11	6.1
2	164.11	351.2	.....	444.8	796.	1.76	1.52	4.9
3	104.25	125.2	220.3	710.7	1056.2	5.88	4.37	10.3
4	108.34	124.8	202.4	405.6	732.8	4.36	2.71	6.8
6	143.32	422.6	180.8	538.4	1141.8	5.48	3.94	8.
7	49.61	119.8	284.1	241.4	645.2	9.01	4.50	13.
8	78.64	140.1	333.9	344.3	818.3	5.20	5.08	10.4
9	147.67	119.8	128.1	224.4	472.7	1.61	.65	3.2
10	100.00	129.6	178.	803.2	1110.8	7.64	5.89	11.1
12	156.97	354.9	79.2	609.	1043.1	3.36	2.57	6.7
13	198.25	735.0	475.	1060.	2270.	7.50	5.72	11.4
14	388.92	285.4	713.6	856.4	2419.2	3.82	2.29	6.2
15	219.82	258.4	537.6	727.6	1523 6	4.86	3.65	6.9
16	172.52	268.8	141.2	596.	1006.	4.36	3.63	6.2
17	275.99	416.4	539.2	864.8	1820.4	5.67	3.86	6.6
18	207.83	324.0	375.2	827.6	1526.8	4.54	1.51	7.4
19	103.81	.....	.....	.....	997.	5.06	3.87	9.6
20	185.25	505.6	77.2	1027.6	1610.4	5.03	3.56	8.7
21	228.62	176.4	390.8	956.8	1524.	4.	3.60	4.9
22	156.00	329.2	190.8	579.6	1099.6	3.24	2.35	4.8
23	177.27	291.0	409.1	734.1	1434.1	5.80	4.06	8.1
Average	165.88	292.19	273.26	644.11	227.93	4.60	3.25	7.4
Percentage	.....	24.1	22.5	53.2	1100.	....	....	....
Mean	.....	.....	.....	.....	.....	4.79	3.40	7.67

The character of fences on the 21 farms is brought out in Table XII, which shows the extent of each of the eight principal kinds of fence and the average cost per rod of all fence on each farm. The total of the eight kinds shown averages 1,204.6 rods per farm, or over 98 percent of the total, a few miscellaneous kinds being omitted. The cost of the various kinds of fence varies with the difference in the cost of materials in different localities, but even more with the height, number of wires or boards, distance apart of posts and the labor expended in construction. "Woven wire" fence, for instance, might be 5 feet in height without barbed wires in addition, or 3 feet in height with several barbed wires above and one below. It might be made of either heavy or light wire, with posts from 10 to 33 feet apart, the posts costing from 10 to 30 cents each. Owing to these variations, estimates on the cost of construction can hardly be made general.

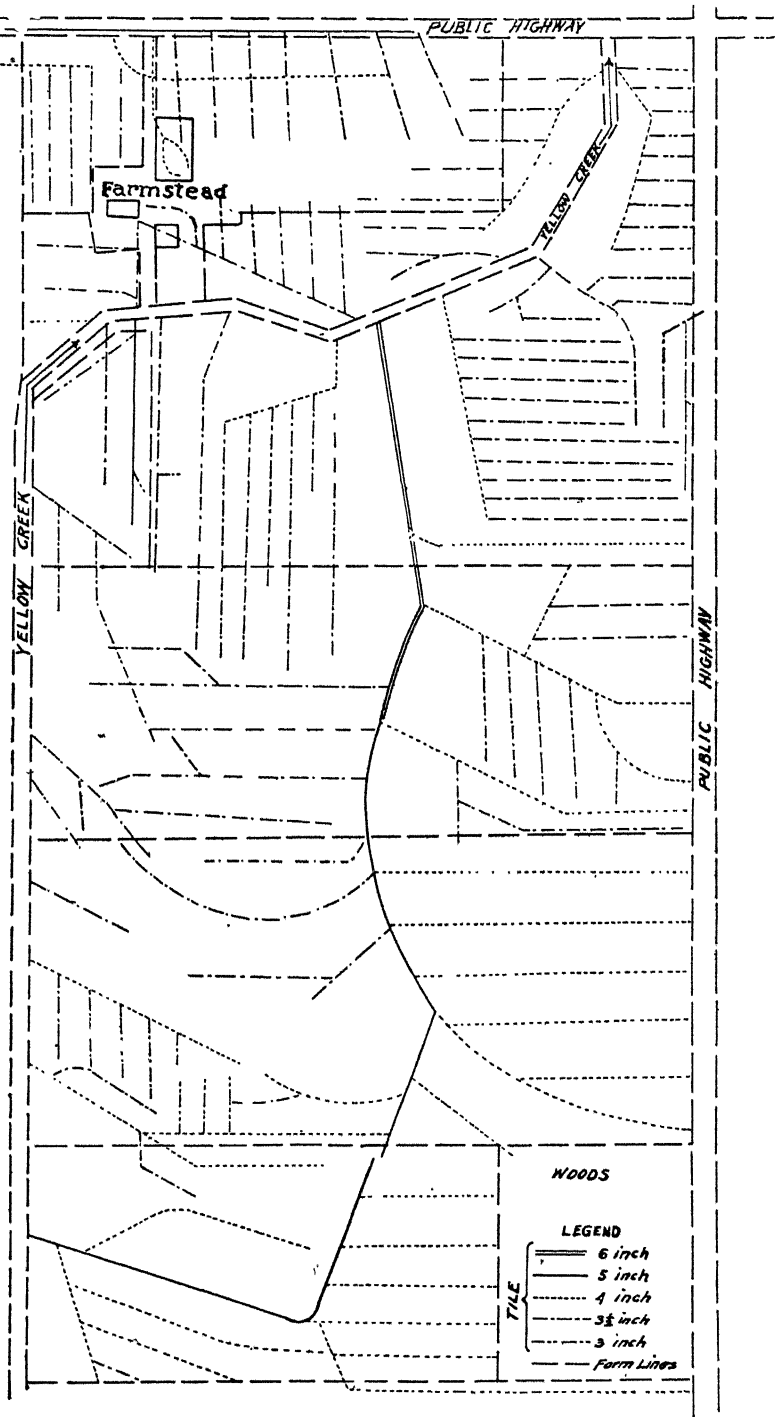

Fig. 2 Drainage system on Farm No. 10.

The old "zigzag" or "worm" fences are still much in evidence, but as they decay are being replaced largely by woven wire. A small percentage have been rebuilt as straight rail fences. The use of barbed wire is somewhat restricted by law, but it is popular as a cattle fence. Board and picket fences, the latter usually made of wire and pickets, are still used somewhat for tight fencing but are being replaced by woven wire. The hedge fences (usually of osage orange) are being torn out on many farms not only because of their unsatisfactory character and the labor of keeping them in shape, but because of the ground rendered unproductive on either side of the fence row. The smooth wire fences include various kinds of wire, many of which have been put out in the effort to supply a fence safer than barbed wire and easier to put up than woven wire.

TABLE XII—NUMBER OF RODS OF EACH PRINCIPAL KIND OF FENCE MAINTAINED BY THE OWNERS OF 21 OHIO FARMS, WITH THE AVERAGE FIRST COST PER ROD OF ALL KINDS OF FENCE ON EACH FARM

Farm No.	Woven wire rods	Barbed wire Rods	Smooth wire Rods	Board Rods	Worm rail Rods	Straight rail Rods	Picket Rods	Hedge Rods	Av. cost per rod Cents
1	70.3	448.2	.....	.....	123.5	65.7	.....	.....	40.9
2	.....	140.	.....	.....	602.	6.	48.	.....	36.4
3	50.8	.....	81.	34.7	624.5	20.	245.3	.....	58.0
4	126.4	.....	36.	28.	277.6	.....	24.	240.8	64.5
6	612.4	.....	272.8	80.	20.	133.8	22.8	.....	68.7
7	28.5	104.7	.....	113.8	134.	26.	.....	47.7	69.4
8	225.	.....	.....	.....	130.6	.....	462.8	.....	50.
9	134.8	.....	.....	31.2	306.2	.....	.....	.....	50.
10	586.	.....	.....	119.2	371.2	20.8	13.6	.....	68.6
12	348.7	.....	493.6	.....	200.8	.....	.....	.....	50.4
13	720.	30.	.....	140.	1140.	93.	37.	110.	65.5
14	605.	643.6	.....	71.6	464.8	535.8	98.2	.....	61.4
15	302.1	680.8	142.4	268.	109.2	.....	21.2	.....	70.
16	186.4	422.8	.....	.....	126.8	.....	270.	.....	74.8
17	986.	.....	.....	216.4	310.	.....	232.8	75.2	86.
18	214.4	.....	.....	267.6	773.6	.....	271.2	.....	61.8
19	.....	.....	180.	245.	408.	60.	104.	.....	52.3
20	305.2	614.8	59.6	202.8	374.8	53.2	.....	.....	57.8
21	356.8	30.4	18.	68.	723.6	86.8	240.4	.....	60.
22	208.8	.....	.....	50.8	811.8	8.	20.2	.....	46.2
23	211.3	765.6	52.	88.	228.3	.....	36.5	52.3	71.7
Average	299.	184.8	63.6	96.4	393.4	38.5	103.7	25.1	59.7
% of total	24.8	15.3	5.2	8.	32.6	3.1	8.6	2.	....

Regarding the cost of construction at the present time, it may be said that this applies almost entirely to board and barbed or woven wire. Hedge fences were formerly installed at about one dollar per rod, and required from 5 to 10 cents per rod per year for trimming. Reference has already been made to the cost of building old rail fences. The labor cost probably ranged between 30 and 50 cents per rod. The material was not valued, and in fact often had no market value at the time the fence was built. The rebuilding of rail fences costs 20 to 30 cents per rod for labor, and if the rails are fastened to posts, one post will be required for each 11-foot

rail length. Picket fences require from 1 to 1¾ posts per rod. The pickets, wire, etc., cost from 60 cents to $1.00 per rod, and the labor of erecting from 15 to 20 cents per rod. None of these types are now built to any great extent.

Barbed wire fences for cattle usually consist of 3 or 4 wires at a cost of 3 to 4 cents per rod for each wire. Intermediate posts are usually set at from 11 to 22 feet apart, costing 5 to 8 cents per post for setting. They are of oak, chestnut, catalpa, osage orange, locust and cedar, principally, costing anywhere from 10 cents up. The corner and brace posts cost from 50 cents up for the posts, and from 50 cents to $1.00 for setting.

Woven wire costs from 25 to 75 cents per rod for the usual heights and grades, the lower heights usually taking several strands of barbed wire in addition. As a rule, posts are set from two-thirds to two rods apart. Setting of posts for woven wire fences costs about the same as for barbed wire, but the end posts must be heavier and more firmly braced, costing as high as $3.00 in some cases for post and setting. The labor of erecting wire fences, outside of setting posts, is estimated at from 5 to 10 cents per rod, but accurate figures are not easily available. This refers, of course, to ready made fence, i. e., not woven on the ground.

Board fences usually require two or more posts, and from 25 to 40 feet of lumber, per rod. The rise in price of fence lumber has practically restricted board fences to the lots about the farmstead. While the estimates must be varied to suit conditions, it is probable that from 45 to 60 cents per acre for barbed wire, 60 to 90 cents for woven wire, and from $1.25 up for board fences will cover the cost.

DRAINAGE

The investment in artificial drainage shown in Table VII represents the cost of installing such improvements. Only a few farms have practically all fields drained. Figure 2 represents the drainage system on Farm No. 10, as shown on the owner's map, all of the farm except the woodlot being tile drained. The owner's map shows the size, depth and location of all tile, this being very convenient when drains are to be cleaned or new ones installed. The cost of the drainage on this farm was $17.70 per acre for the whole farm and about $18.60 per acre drained.

The average of the 21 farms showed an investment of $366.43 per farm for drainage. At the rate prevailing on farm No. 10, this would tile about 20 acres thoroughly. In practice, however, "strings" of tile are found only in the low places, and a much larger area could be drained. The work of digging the ditches and laying the tile is often done by contract at the rate of from 6 to 10 cents per

"rod foot" for small tile, i. e., a ditch 1 rod long, 1 foot deep, and wide enough to allow the placing of tile from 2½ to 5 inches in diameter. Ditching machines usually do the work somewhat cheaper than it can be done by hand. The cost of ditching for larger tile is greater, but not in proportion to the size of the tile, reaching 12 to 16 cents per rod foot for 12 and 15 inch tile. Filling the ditches is usually done with a team and plow at a very slight cost. The tile varies in price with locality. The 2½ inch tile costs 14 to 16 cents per rod; 3 inch, 16 to 20 cents; 4 inch, 19 to 25 cents; 5 inch, 30 to 36 cents; 6 inch, 40 to 50 cents; 8 inch, 70 to 80 cent; 10 inch, $1.00 to $1.40. These figures are from farmers. Tile is frequently sold by the hundred or the thousand, 16 pieces being counted to the rod.

WATER SUPPLY

Owing to the wide variation in the character of water systems, it will hardly be possible to make even an approximate list of the essentials for the average farm. The average present value of the water system, appraising wells at the cost of installation,and pumps, tanks, etc., at their present value, is seen to be $171.76 (Table VIII) for the 21 farms. Allowing for depreciation on the latter items, it is probable that the average cost would reach $225 for the entire system. Between different farms, however, there is a wide range, as shown by Table III. The larger number of these farms depend upon dug wells from 25 to 40 feet in depth and from 3 to 4 feet in diameter. Such a well, for digging and walling, costs $1.00 to $1.25 per foot in depth. A hand pump, costing from $5.00 to $10.00 is usually found in this sort of well. Some of the farms have drilled wells from 90 to 150 feet deep. These cost in the neighborhood of $1.00 per foot for drilling and casing, and require a more expensive pump, costing from $15 to $25 for the pump, piping and cylinder. One or more cisterns are usually found, ranging in size from 20 to 150 barrels and costing from $10 to $35. A cistern pump complete usually costs from $4.00 to $6.00. Where water is conveyed to tanks or troughs at some distance from the well, piping of 1 or 1¼ inch is ordinarily used, at a cost of from 8 to 12 cents per foot. Small wooden troughs, holding from 1 to 3 barrels and costing from $3.00 to $5.00, are often used in connection with wells or cisterns near the barn, but tanks holding from 10 to 50 barrels are commonly used in feed lots. These cost from $10 up, in wood, and a trifle more in concrete. Many permanent concrete tanks are being installed by farm labor at a cost of from $15 to $40 for sizes ranging from 20 to 80 barrels. Windmills costing from $50 to $150 are often found economical. The usual height of tower is from 25 to 30 feet,

with a wheel 6 to 8 feet in diameter. These cost in the neighborhood of $60 to $70. Gasoline engines used only for pumping are occasionally found. These are usually of 2 or 3 horsepower and cost from $75 to $150. Reservoirs are sometimes found necessary in connection with deep wells and windmills. These store up a surplus of water at a depth from which it can be easily pumped by hand when a lack of wind cuts off the supply from the well. The cost of construction is about the same as for cisterns.

PERSONAL PROPERTY

The requirements of the average farm as to livestock and machinery are discussed in the following pages, including Table XIII, which was compiled from the inventories.

HORSES

In Table XIII the horses and mules on the 21 farms are divided into 5 classes with respect to use. The general purpose, draft, and draft and brood classes might be grouped as work animals, with an average of 4.48 per farm, but the subdivision indicates a little more clearly the character of the animals. The draft and brood animals are mares regularly worked rather than mares kept for breeding purposes only. The general purpose animals are those used for both work and driving on several small farms. The data indicate that 4 work horses, 2 head of young stock, and either a driving horse or brood mare, which may occasionally be worked, as about the average requirements as to horses.

The 94 horses used partially or wholly for heavy work on the 21 farms averaged 1250.3 pounds in weight. From Table II it will be seen that these farms averaged 85.71 acres of harvested crops. This would mean an average of 19.13 acres of crops per work animal. The acres of crops per work animal varied from between 10 and 11 acres on farms Nos. 3, 7 and 22, to 31.1 acres on farm No. 17. Taking all the farms visited by Mr. Thompson and all those of the statistical cooperators, 55 in all, there was an average of 8.4 horses per farm. Fifty-four of these farms from which data were more complete averaged 199.55 acres in size and 125.54 acres in harvested crops. There was an average of 5.39 work horses per farm and an average of 23.3 acres of harvested crops per work animal. On one group of 27 farms, averaging 153.65 acres in size, there were 18.9 acres of crops per work animal, and on a group of 17 farms averaging 272.44 acres, the average crop area was 27.5 acres per work animal.

The farms visited by Mr. Thompson were mostly in the level "large farm" area of Ohio, i. e., the southwestern part. Seventeen farms visited by him in 1907 and 1908 maintained 119 work horses, averaging 1,368 pounds in weight, with an average value of $158.91

and an average age of 8.98 years. On farms Nos. 20 to 23, inclusive, in the "hill section," 17 work animals, averaging almost exactly 7 years in age, and 1170 pounds in weight, were valued at $146.41 each. These farms average 186.79 acres in size, but average only 65.4 acres in crops, or 15.4 acres per animal. Fifty-two farms, including those of cooperators, maintained 275 work horses, averaging 1,306 pounds in weight.

The work stock, like machinery, is seldom utilized to its full capacity on small farms or where conditions cut down the crop area. The number of work animals needed depends not only upon the acreage of crops but upon the total area of the farm, the kind and extent of livestock enterprises, the kind of crops, the topography, the distance of the farm from town and numerous other factors which could not be studied in detail at this time. In most cases the number of work animals is determined by the minimum power requirements during the two busiest seasons—seed time and harvest.

CATTLE

The values for cattle on these farms in the winter and spring of 1909 are approximated in the column of costs per unit. These will, of course, fluctuate with the market and the round numbers are used for convenience. They are based, however, on averages except as otherwise stated. One hundred dollars has been set arbitrarily as a fair price for a good bull of either a beef or dairy type, and $40 has been taken as nearer the usual value of a beef cow than the actual average on two farms reporting. On one of these there were 14 Shorthorn cows valued at $100 or more each, and on the other there were 4 grade cows valued at $35 each. Steers were figured on the prices of 4 to 4½ cents prevailing at that time, and young beef stock at about the average value per head.

On farms Nos. 1, 2, 6, 9, 21 and 23, on which dairying is the principal enterprise, there were 95 milch cows with an average value of $40.84 per head. These included some pure bred cows. On 10 other farms there were 29 milch cows, averaging $37.72 per head. The average value of 124 cows on 16 farms was $40.18 per head. The 6 dairy farms averaged $648 worth of milch cows per farm and the 10 other farms $109.40 per farm. On the 6 dairy farms there were 44 head of young stock, or nearly 1 head for each 2 milch cows. The figure for the value of young stock is close to the average for all calves and heifers found on these farms.

SHEEP

The value of $10 per ram is a trifle higher than would be true of many farms, owing to the presence on Farm No. 17 of a number of rams at $12.50 each which were raised for sale as breeding

animals. This figure given, however, is none too high for good results. All lambs at foot are included in the value of the breeding ewes. Feeding wethers, lambs and ewes are grouped under "Wethers, etc."

SWINE

Swine are quoted at a round figure approximating the average value on these farms at that time, as follows: Boar $15; sow $14; shoat $6.25; pig $2.50. Several fat hogs are included under "Shoats," and the dividing line between "shoats" and "pigs" is not absolute. About 5½ cents per pound was the farm value of hogs at the time the inventories were taken.

MACHINERY, TOOLS, ETC.

As stated elsewhere, the first cost of the great number of minor articles of farm equipment not mentioned in Table XIII would probably be from $200 to $300 by the time the outfit was complete for the average Ohio general farm of 160 acres. This figure, however, would include an appropriation of $50 or more for repair materials, which in this report are invoiced with produce, supplies, etc. Taking all the minor items other than repair materials for 33 farms, using the ordinary retail prices and dividing by the number of farms, the first cost of minor items for the average farm of 167 acres was found to be about $190.

In taking an inventory of the small items many were doubtless omitted, and $200 is probably a low enough figure to allow for the average equipment of this sort.

TABLE XIII. NUMBER OF MAJOR ITEMS OF PERSONAL PROPERTY FOUND ON 21 OHIO FARMS, WITH THE AVERAGE NUMBER OF EACH ITEM FOR ALL FARMS, AND FOR EACH FARM REPORTING THE ITEM, THE APPROXIMATE COST OF EACH ITEM, AND THE AVERAGE COST OF EACH ITEM FOR EACH OF THE 21 FARMS.

Name of Article	Number reported	No. of farms reporting	Av. No. per farm reporting	Av. No. per farm, all farms	Approximate cost or value	Total cost or value per farm, all farms
Horse—General purpose...	6.0	3	2.0	0.29	$140.83	$ 40.24
Horse—Driving.....	17.0	10	1.7	0.81	104.12	84.29
Horse—Draft.....	73.0	18	4.06	3.48	145.82	506.90
Horse—Draft and brood...	15.0	6	2 5	0.71	131.00	93.57
Colts.....	38.0	13	2.92	1.82	92.11	166.66
All horses.....	149.0	21	7.1	7.10	125.64	891.66
Double work harness.....	52.0	21	2.5	2.48	35.00	86.80
Single work harness.....	2.0	2	1.0	0.10	20.00	2.00
Double light harness.....	11.0	11	1.0	0.52	25.00	13.00
Single light harness.....	41.0	21	2.0	1.95	15.00	29.25
Bull.....	10.0	10	1.0	0.47	100.00	47.00
Milch cows.....	163.0	21	7.8	7.76	40.00	300.40
Young dairy stock.....	75.0	15	5.0	3.57	16.00	57.12
Beef steers.....	43.0	2	2.6	2.04	44.00	89.76
Young beef stock.....	40.0	4	10.0	1.90	18.00	34.20
Ram.....	21.0	8	2.6	1.00	10.00	10.00
Ewes—breeding.....	361.0	9	40.1	17.19	6.25	107.44
Wethers, etc.....	482.0	4	120.5	22.90	3.50	80 15
Boar.....	8.0	9	0.9	3.80	15.00	5.70
Brood sow.....	90.0	15	6.0	4.28	14.00	59.92
Shoat.....	288.0	13	22.1	13.71	5.00	68.55
Pig.....	226.0	11	20.5	10.76	2.50	26.90
Hen.....	1768.0	21	84.2	84.19	0.55	46.30
Rooster	113.0	20	5.7	5.38	0.55	2.96
Other poultry.....	44.0	9	4.9	2.09	1.00	2.09

TABLE XIII. Continued.

Name of article	Number reported	No. of farms reporting	Av. No. per farm reporting	Av. No. per farm, all farms	Approximate cost or value	Total cost or value per farm, all farms
Bees (stand)	34.0	8	4.3	1.61	$ 2.50	$ 3.14
Walking plow	40.0	21	1.9	1.90	10.00	19.00
Sulky plow	4.0	4	1.0	0.19	35.00	6.65
Gang plow	6.0	6	1.0	0.28	65.00	18.20
Spike tooth harrow	27.0	21	1.3	1.29	15.00	19.35
Spring tooth harrow	7.0	6	1.2	0.33	16.00	5.28
Acme harrow	1.0	1	1.0	0.05	18.00	0.90
Disc or cutaway harrow	18.5	19	1.0	0.88	33.00	27.94
Roller or crusher	13.5	14	1.0	0.64	25.00	16.00
Planker	11.0	10	1.1	0.52	3.00	1.56
Weeder	14.0	15	0.9	0.66	10.00	6.60
Shovel plow	15.0	14	1.1	0.71	2.50	1.78
Manure spreader	11.5	13	0.9	0.54	125.00	67.50
Corn stalk cutter	1.0	1	1.0	0.05	25.00	1.25
Farm wagon and box	28.0	21	1.3	1.33	75.00	99.75
Truck or "handy" wagon	11.0	11	1.0	0.52	30.00	15.60
Spring wagon	11.0	10	1.1	0.52	75.00	39.00
Road cart	6.0	5	1.2	0.28	25.00	7.00
Hand cart	4.0	4	1.0	0.19	5.00	0.95
Carriage	14.0	13	1.1	0.66	100.00	66.00
Buggy	33.0	20	1.6	1.57	75.00	117.75
Sled	20.0	15	1.3	0.95	30.00	28.50
Cutter or sleigh	9.0	9	1.0	0.42	30.00	12.60
Road drag	3.0	3	1.0	0.14	3.00	0.42
Stone boat	15.0	10	1.5	0.71	2.00	1.42
Stock rack	5.0	4	1.3	0.23	10.00	2.30
Gravel or dump bed	3.0	3	1.0	0.14	6.00	0.84
Scraper or slip	3.0	3	1.0	0.14	5.00	0.70
Gasoline engine	5.0	5	1.0	0.23	200.00	23.00
Babcock tester	2.0	2	1.0	0.09	5.00	0.45
Aerator	1.0	1	1.0	0.05	5.00	0.25
Refrigerator	1.0	1	1.0	0.05	15.00	0.75
Cream separator	8.0	8	1.0	0.38	65.00	24.70
Combination churn	1.0	1	1.0	0.05	30.00	1.50
Corn planter—1 horse	3.0	3	1.0	0.14	18.00	2.52
Corn marker	6.0	6	1.0	0.28	2.00	0.56
Corn planter—2 horse	8.0	10	0.8	0.38	50.00	19.00
Cultivator—2 or 3 horse	30.0	17	1.8	1.43	28.00	40.04
Cultivator—1 horse	27.0	18	1.5	1.28	5.00	6.40
Corn binder	4.75	6	0.7	0.21	125.00	26.25
Sled harvester	2.0	2	1.0	0.09	25.00	2.25
Corn shocker	2.0	2	1.0	0.09	120.00	10.80
Corn shredder	0.6	2	0 3	0.03	175.00	5.25
Ensilage or fodder cutter	6.0	6	1.0	0.28	40.00	11.20
Corn sheller	14.0	13	1.1	0.66	6.00	3.96
Circular woodsaw	5.0	5	1.0	0.23	8.00	1.84
Grain binder	16.0	18	0.9	0.76	125.00	95.00
Grain drill	17.0	15	1.1	0.80	65.00	52.00
Fanning mill	11.5	12	1.0	0.54	25.00	13.50
Reaper	1.0	2	0.5	0.05	45.00	2.25
Hay loader	5.5	6	0.9	0.26	55.00	14.50
Mower	23.5	21	1.11	1.11	45.00	49.95
Hay rack	22.0	18	1.2	1.04	10.00	10.40
Hay rake—sulky	17.5	19	0.9	0.83	20.00	16.60
Hay rake—wooden	1.0	1	1.0	0.05	5.00	0.25
Wheelbarrow seeder	2.0	2	1.0	0.09	8.00	0.72
Tedder	9.5	10	1.0	0.45	38.00	17.10
Potato cutter	0.5	1	0.5	0.02	6.00	0.12
Potato planter	3.5	4	0.9	0.16	55.00	8.80
Potato sprayer	3.5	4	0.9	0.16	25.00	4.00
Potato plow (digger)	4.0	4	1.0	0.19	15.00	2.85
Potato digger	2.5	3	0.8	0.11	90.00	9.90
Potato sorter	2.0	2	1.0	0.09	20.00	1.80
Sap evaporator	6.0	6	1.0	0.28	100.00	28.00
Sap gathering tank	4.0	4	1.0	0.19	8.00	1.52
Sap storage tank	8.0	5	1.6	0.38	12.00	4.56
Sap sled	3.0	3	1.0	0.14	3.00	0.42
Orchard sprayer	5.0	6	0.8	0.23	20.00	4.60
Cider mill	3.0	3	1.0	0.14	10.00	1 40
Fertilizer spreader	1.5	2	0.8	0.07	25.00	1.75
Feed grinder	3.0	4	0.8	0.14	40.00	5.60
Fruit evaporator	2.0	2	1.0	0.09	50.00	4.50
Litter carrier	1.0	1	1.0	0.05	30.00	1.50
Beet cutter	1.0	1	1.0	0.05	25.00	1.25
Beet lifter	1.0	1	1.0	0.05	15.00	0.75
Tread power	1.0	1	1.0	0.05	40.00	2.00
Incubator	4.0	3	1.3	0.19	10.00	1.90
Brooder	2.0	2	1.0	0.09	7.00	0.63

The prices for harness, machinery, etc., in Table XIII are, as nearly as can be ascertained, the usual retail prices prevailing in Ohio for new articles. Both farmers and merchants were consulted in the effort to obtain these figures, but of course they are merely suggestive. The first values shown later in Table XIV include both first and second hand prices and may be regarded as indicative of the usual farm practice.

In making up a list of machinery for the average farm there are so many factors to be taken into consideration that a generalization would be of little value. The number of any single item reported for all the farms, the average for all farms, the percentage of farms reporting the article, and the number of articles per farm reporting are all to be regarded as useful in separating the necessary items from those only occasionally or rarely used. A careful study of the first four columns in Table XIII is recommended as of more value than a suggested list, especially with the major items of equipment shown in this table. For the purpose of this study it is desired only to obtain an average figure for the total first cost of machinery and tools, hence the average number of each item on the 21 farms is multiplied by the usual cost and the total secured in this way.

TOTAL COST OF EQUIPPING THE FARM

From the foregoing discussion it will be possible to make a summary, showing more or less accurately the first cost of equipping the "average farm" under consideration. In the case of livestock and produce, supplies, etc., the actual inventory valuations are taken from Table VII rather than approximations which might be obtained from Table XIII.

The total would be as follows:

Land, 165.88 acres at $46.25 (average)	$ 7,676.42
Farm buildings	2,700.00
Household buildings	2,500.00
Fences	763.74
Drainage	366.43
Water Supply	225.00
Work Animals	640.71
Colts and driving horses	250.95
Cattle	582.26
Sheep	201.05
Swine	158.34
Poultry	52.60
Bees	3.23
Harness	131.05
Machinery	1,125.48
Minor articles	200.00
Produce, supplies, etc.	631.93
Total	$18,209.19

As the practice in housing poultry on the average farm is bad, this figure might be slightly increased, although much more desirable poultry houses might be constructed as economically as the average ones used.

Total value of real estate	$14,231.59
Total value of personal property	3,977.60
Percentage invested in real estate	78.15
Percentage invested in personal property	21.85

In actual practice innumerable factors enter in to reduce the cost of equipping farms. Few farms in the older sections of the United States like Ohio are equipped outright with new buildings, fences and machinery, and the summary just given would, of course, apply only in these few cases. It is interesting, however, in showing the amount of money which can be spent over a course of years in bringing the equipment up to a profitable working basis. The 21 farms studied in such detail are not in any sense exceptional or "model" farms. They represent a large class, probably more successful than the average, and no doubt the detailed estimates of their average equipment cost will be found helpful, as a guide to planning the proper distribution of capital.

UNIT EQUIPMENT COSTS

The third phase of this study was made less prominent than the two already discussed. This phase is that of current equipment charges on farm operations, including machinery costs per acre of crop, building charges per head of livestock, and storage or building charges per unit of products. From the circulars sent out to the Ohio corn growers, from Mr. Thompson's notes and from the inventories on the farms of cooperators, have been gathered considerable data regarding the machinery costs, but the determination of annual and unit costs of buildings, fences, etc., has not been attempted because of the meager information at hand.

That there is a distinct cost each year for buildings, fences and other improvements is undisputed, but the exact amount is difficult to ascertain, owing to the lack of information concerning the rate of depreciation on such equipment. The depreciation on the modern steel wire fences is rapid, and often excessive, while many of the old rail, wire and picket fences are in good condition after years of service. The ordinary farm usually has from three to ten kinds of fence, hence the securing of data of this sort was found to be too complex for the present study. Building depreciation varies with the construction and subsequent care, as well as with the use to which different structures are put. The increase in the cost of construction during the last generation has equalled

if not exceeded the depreciation from the original value, hence the determination of interest and depreciation involves more study than could be given at this time. The annual deterioration in condition is probably from 2 to 5 percent of the original standard in case of buildings, and from 6 to 20 percent in case of fences. If no change occurs in the cost of construction, the annual depreciation, repair and interest charges could be added and the total charge apportioned to the various units, but further investigation is necessary before averages can be presented in this connection.

Regarding machinery costs the problem is simpler. Prices have not changed so materially, the annual rate of depreciation is more easily obtained, and the amount of use each year more easily reduced to a unit basis. Table XIV shows in detail the data on machinery costs, either on the annual or acre basis. The number of machines included in the final average is shown in the first column. In many cases there were unit costs which were clearly out of the usual range of probability, and these were discarded in taking the average. The first value at time of purchase by the farmer reporting is shown, this average including many second-hand machines. The "second value" is the inventory rather than the sale value. The average investment is obtained by averaging the first value and the value at the beginning of the last season. The latter is obtained by adding to the value at the close of the last season, as shown by the inventory, the average depreciation. This method produces the same result as would be obtained by assuming that the rate of depreciation were constant throughout the period of use of the machine up to date and averaging the values at the beginning of each season. The method involves a slight possibility of error, due to the fact that the repairs are not put on at a constant annual rate, and the actual difference in inventory would be somewhat affected. The discrepancy would be negligible. The average years in use up to the last date of inventory is shown, and from this and the difference between the first and second values, the annual rate and percentage of depreciation are obtained, the percentage being based on the first value. The repairs per year are from actual records or careful estimates. The interest is calculated at five percent on the average investment. The annual cost is the sum of depreciation, repairs and interest. The lowest and highest acre costs for different machines are shown, though these are not always included in the average. The lowest figure is usually for a second-hand machine used on a large acreage or for a long period, while the largest is usually for a new machine given very little use. Extra machines on any farm show a much higher cost than those in ordinary use. The interest charge is the greatest factor in the

cost of little used machinery, emphasizing the advantage of utilizing machines to their maximum capacity. All data in Table XIV are averages of the entire group and not a mean between individual costs.

The wide variation in acre cost of all machinery suggests the necessity for considering the acreage per year as an extremely important factor. For instance, sixty corn planters averaged 50.1 acres per year at an acre cost of 8.1 cents; 24, averaging 63 acres, cost between 4 and 8 cents per acre; and 15, averaging 34 acres, cost from 10 to 13 cents per acre. This separation of planters into two groups was suggested by the appearance of curves plotted to show the frequency of different acre costs for all the machines. Extremely high costs in a few cases were sufficient to raise the averages considerably above the cost occuring most frequently. The curve of planter costs showed two distinct groups, with the average midway between. It is evident that machinery costs should be studied for different acreages, especially since the annual cost of the same machine on different farms varies much less widely than the acre costs.

Only 9 out of 130 walking plows cost over 20 cents per acre and these were excluded from the average. The question of plow costs in the "hill section" was raised. Twenty plows in this section showed an average of 6.1 cents per acre and a mean of individual costs of 7.2 cents. The first value was $13.20; second value, $6.80; average investment, $10.40; years used, 9.15; annual depreciation, 71 cents; percentage of depreciation, 5.3; acres per year, 26.3. The uniformity of these figures with the average for the whole number was surprising, especially in view of the low percentage of crop area in case of many farms in this section.

The cost shown for cultivators, harrows, rollers, plankers and weeders is on the basis of one acre covered once, or the "acre time.' Since in the tillage of an acre of land the same implement may be used a varying number of times the acre time is considered a more logical unit than the acre. One spring tooth harrow covering a total of 250 acres per year at 0.7 cents per acre time and one covering 10 acres per year at 17 cents per acre time are omitted from the average. The roller operating at 0.4 cents per acre time was used 300 acre times per year. Excluding this one, the cost per acre time was 2.4 cents. About 4-5 of the rollers cost between 0.5 and 5 cents per acre time. The wooden planker, drag, or float, as it is variously called, is usually home-made, hence the low first cost. Many home-made wooden rollers are also found. Weeders range rather uniformly from 2 to 12 cents per acre time. One, which covered the equivalent of 300 acre times per year at a cost of 0.3 cent was omitted from the average.

TABLE XIV, COST PER ACRE AND PER YEAR OF MACHINERY ON OHIO FARMS

Kind of machine	No.	First value	Second value	Average investment	Years in use	Depreciation		Repairs per year	Interest per year	Total cost per year	Acres worked per year	Acre cost		
						Per year	Percent					Low	High	Average
Walking plow	115	$ 13.60	$ 6.95	$ 10.62	9.6	$ .69	5.1	$0.71	$0.53	$ 1.93	27.1	$ 0.018	$ 0.359	$ 0.072
Riding or gang plow	42	47.22	33.05	40.17	5.6	2.54	5.4	0.96	2.01	5.25	28.8	0.017	0 42	0.183
Harrow, spike	74	12.47	6.83	9.99	8.3	0.68	5.5	0.29	0.50	1.47	79.2	0.005	0.108	0.019
Harrow, spring	16	17.00	7.72	12.88	9.0	1.03	6.0	0.21	0.64	1.89	38.8	0.009	0.17	0 027
Harrow, disc	62	26.90	14.93	21.62	7.4	1.62	6.0	0.27	1.08	2.97	60.4	0 005	0.317	0.049
Roller	23	22.50	14.09	18.67	11.3	0.75	3.3	0.03	0.93	1.71	84.2	0.004	0.092	0.02
Planker or drag	13	2.94	1.42	2.30	6.5	0.24	8.0	....	0.11	0.35	45 4	0.002	0 035	0.008
Weeder	19	10.79	5.76	8.29	7.2	0.70	6.5	....	0.41	1.11	34.4	0.013	0.173	0.033
Manure spreader	46	112.25	82.93	102.24	3.2	9.30	8.3	1.58	5.11	16.29	....	* 7.81	*49.38	*16.29
Corn planter	60	35.45	18.29	27.97	7.8	2.20	6.2	0.47	1.40	4.07	50.1	0.02	0.299	0.081
Cultivator, 1 horse	12	4.79	2.58	3.81	8.5	0.26	6.3	0.07	0.19	0.52	12.1	0.018	0.068	0.043
Cultivator, 2 or 3 horse	102	24.51	12.00	19.04	7.9	1.57	6.3	0.34	0.95	2.86	69.7	0.009	0.418	0.041
Corn binder	28	105.32	51.78	82.79	6.3	8.48	8.0	1.60	4.14	14.26	38.5	0.199	2.22	0.369
Corn shocker	6	120.83	69.17	101.46	4.0	12.92	10.7	0.79	5.07	18.78	22.3	0.248	2.78	0.842
Grain binder	24	117.11	46.96	86.10	8.6	8.13	7.0	1.10	4.31	13.54	51.1	0.128	0.688	0.264
Grain drill	40	59.69	35.35	48.75	8.7	2.81	4.7	0.33	2.44	5.58	43.0	0.018	0.397	0.13
Fanning mill	11	20.81	13.72	17.64	9.3	0.76	3.7	....	0.88	1.64	....	* 0.41	* 2.58	* 1.64
Hay loader	12	57.75	30.29	45.76	7.9	3.47	6.0	0.65	2.89	7.01	28.3	0.13	0.488	0.248
Mowing machine	45	41.64	21.67	32.94	7.8	2.56	6.1	0.93	1.65	5.14	49.1	0.04	0 558	0.105
Hay rake	35	19.21	9.86	15.09	8.5	1.11	5.8	0.26	0.75	2.12	38.8	0.005	0.347	0.055
Hay tedder	20	31.70	18.60	25.96	8.0	1.63	5.2	0.40	1.30	3.73	22.5	0.015	0.427	0.164
Wagon	76	62.72	28.26	46.99	11.5	3.00	4.8	1.20	2.35	6.55	....	* 1.23	*11.21	* 6.55
Corn shredder	5	474.30	344.80	431.14	3.0	43.17	9.1	0.98	21.56	65.71	....	*37.25	*84.50	*65.71
Ensilage cutter	11	111.04	71.36	94.36	6.3	6.32	5.7	0.83	4.72	11.87	....	* 2.21	*36 80	*11.87
Corn sheller	11	9.74	5.34	7.73	11.5	0.38	3.9	0.04	0.39	0.81	....	* 0.22	* 2.26	* 0.81

*Annual cost

No records are at hand as to the acres covered by many of the manure spreaders, and of course the cost of fanning mills, wagons, corn shredders, ensilage cutters and corn shellers can not well be reduced without difficulty to an acre basis. Annual costs are given in these cases. The mean acre cost of 12 spreaders was 87 cents, and the mean cost (or machinery charge) per load for 12 other spreaders was 5.9 cents. It is interesting to note that the average years in use for spreaders is much lower than that of most machines. The majority of spreaders in use are probably innovations on the various farms, hence the cost data are more difficult to secure than those for machines introduced earlier.

Excluding second-hand implements, the cost per acre time for one-horse cultivators ranges from 2.6 to 6.8 cents, with the greater number between 4 and 5 cents. A few three-horse (double row) cultivators are included with the two horse. Only 3 of the 2- or 3-horse cultivators cost over 13 cents per acre time. One of these was an extra cultivator, bought second-hand and used on only 15 acres in 4 years. The bulk of cases ranged between 1 and 10 cents per acre time, 35 out of 102 being between 2 and 4 cents, 24 between 4 and 6 cents, and 12 below 2 cents.

The acre cost of corn binders varies greatly, but in about half the cases was between 25 and 45 cents per acre. Two sled harvesters cost less than 10 cents per acre. The corn shockers reported were used on a much lower acreage than the corn binders, with a much higher acre cost. The wide variation in size and first cost of ensilage cutters makes the average of doubtful value. Two cutters cut about 120 tons each per year at costs of about 7 cents per ton, while another cut about 1,250 tons per year at a cost of 2.9 cents per ton. Three two-hole corn shellers had a mean cost of $2.01 per year, while 7 out of 8 one-hole shellers cost less than 60 cents per year. The few years in use undoubtedly account for the remarkably low repair cost in the case of the corn shredder. Fourteen grain binders cost between 15 and 30 cents per acre. Grain drills ranged very uniformly between annual costs of about $1 and $10, and acre costs of from 6 to 20 cents.

The acre cost of mowing machines varied uniformly between 4 and 18 cents, 35 out of 45 machines being within these limits. The annual cost of 20 out of 35 hay rakes was between $1 and $2.50.

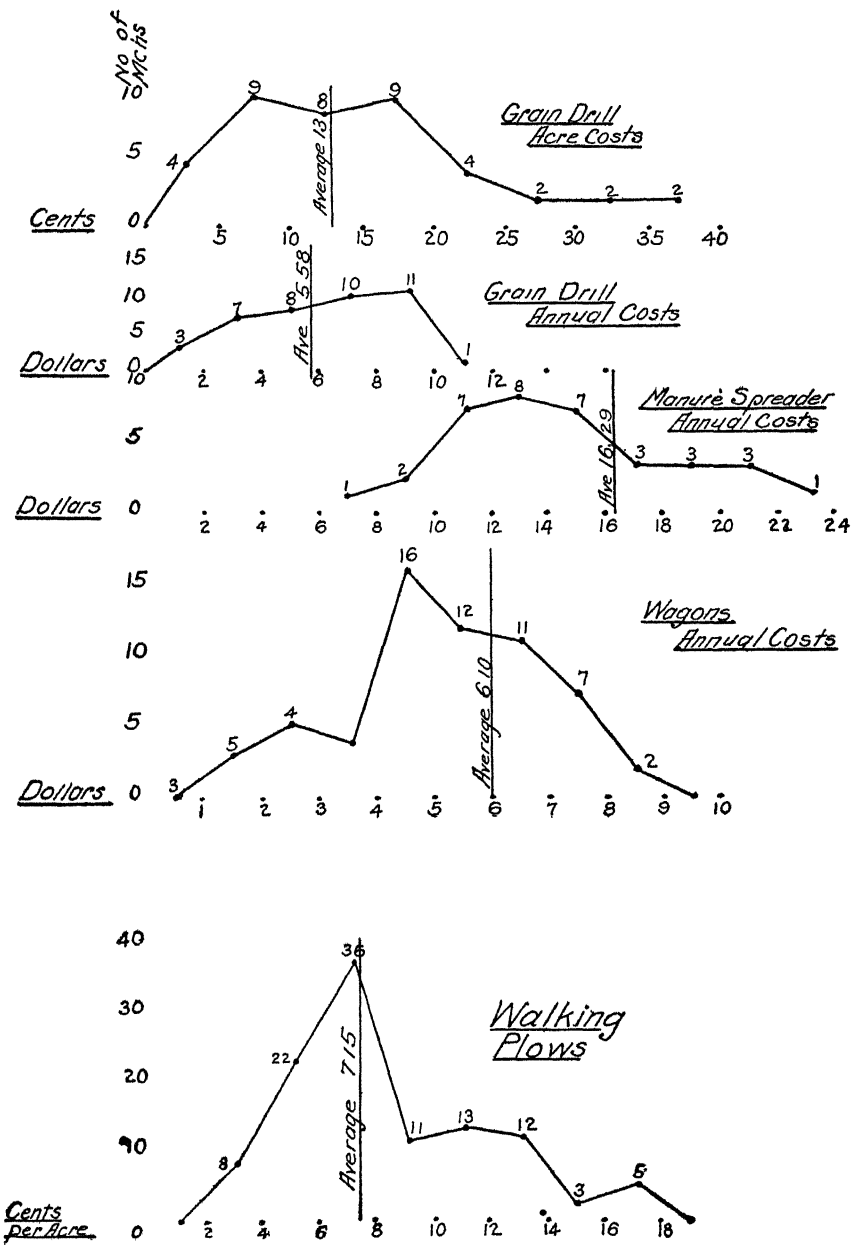

Fig. 3. Showing frequency of acre and annual costs of different farm implements.

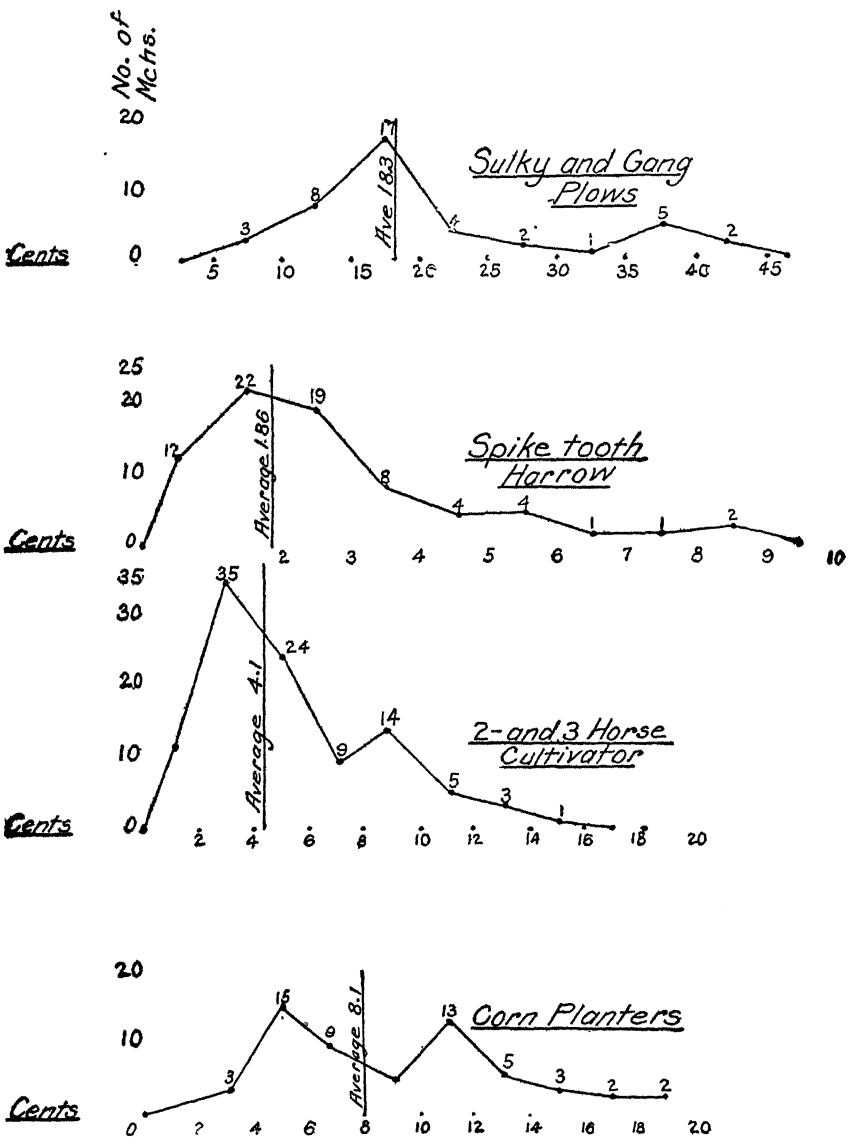

Fig. 4. Showing frequency of acre and annual costs of different farm implements

The cost of these 20 rakes ranged from 2.4 to 16.8 cents per acre time, with a mean of 7.3 cents. This is probably a better figure than the average (5.5 cents) give in Table XIV. In the latter are included a number of revolving wooden rakes and second-hand steel rakes at a cost of 0.5 to 2.5 cents per acre, and two side-delivery rakes at 17.1 and 29.4 cents, respectively. Thirteen out of 20 hay tedders cost between 15 and 25 cents per acre. The lowest figure is for a second-hand machine and the highest for a machine tedding an average of 5 acres per year. The lowest annual wagon costs are due to truck, or "handy" wagons and to those not purchased new. Sixty percent of wagon costs are between $4 and $8 per year.

Figures 3 and 4 give diagrams to illustrate the frequency of various acre and annual costs for different machines. The height of the points on each curve indicates the relative number of machines with costs within the range indicated by the figures on the base line. Of walking plows, for instance, 8 cost between 2 and 4 cents per acre, 22 between 4 and 6 cents, and so on. The average cost for the entire group is shown. Usually it is higher than the acre or annual costs which are most frequent, owing to the influence of abnormally high costs. Where the latter were widely separated from the others, as in the case of one manure spreader with an annual cost of $49.38 and 3 wagons costing over $11 per year, they are not shown on the diagram. The curves show, more clearly than the average, the cost of the greater number of machines, but the average is valuable because of the consideration given to the most and least as well as the normally expensive ones.

While the lack of numbers makes the data suggestive rather than conclusive, they present a fair basis for estimates of the machinery cost of producing crops.

SUMMARY

Proper organization is prerequisite to successful farm management. Proper organization refers not only to the cropping system, live stock management, etc., but to the distribution of capital and the selection of equipment. This study of a number of Ohio farms does not afford sufficient data from which to draw general conclusions, but illustrates by concrete example many of the factors to be taken into consideration in equipping farms. Further study along the lines indicated should provide data of great value to the farm manager. This outline of some of the economic problems involved in the equipment of farms is presented as worthy of the attention of students of farm management and of farm economics in general.